THE IMPACT OF METROPOLITAN CONSOLIDATION ON FISCALLY INDUCED MIGRATION: AN ECONOMETRIC SIMULATION APPROACH

By

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A DISSERTATION PRESENTED TO THE GRADUATE COUNCIL OF
THE UNIVERSITY OF FLORIDA
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1977

ACKNOWLEDGEMENTS

The author wishes to thank his Chairman, Professor Jerome Milliman, for his wisdom, guidance and friendship throughout the course of this study. Special thanks is given to Professors Henry Fishkind and Blaine Roberts, whose conscientiousness and support were invaluable. The author would also like to express his appreciation to Professors Fred Goddard and Gary Lynne for their contributions.

Finally, the author extends his profound gratitude to his wife for her love, constant personal support and professional editing skills. The author's parents were also an invaluable source of love and understanding.

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of the University of Florida in Partial Fulfillment of the Requirements
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December 1977

Chairman: Jerome W. Milliman
Major Department: Economics

This study focuses on the degree to which fiscal variations in a metropolitan area influence residential location. Efforts to explain this aspect of locational behavior have essentially resulted in the empirical testing of the Tiebout hypothesis, which states that an individual will locate in that community which provides the mix of public services and taxes best suited to his own tastes and preferences. In other words, the Tiebout hypothesis seeks to explain the phenomenon of "voting with one's feet" whereby individuals can gain fiscal advantages by their choice of residential location.

It is assumed that governmental consolidation will eliminate the source of metropolitan fiscal variations which result from differing allocations of revenues and tax burdens. Therefore, if residential is in part determined by fiscal variations across a metropolitan area, then the implementation of a consolidated government can be expected to influence residential choice. Thus, the model developed in this study is important on both a theoretical and an institutional basis.

The model is primarily concerned with middle class residential location. It is assumed that this income group represents the primary

component of the urban decentralization trend. Furthermore, it is hypothesized that this group will react to the Tiebout forces. However, the determinants of middle class location are used to estimate the location of upper and lower income groups. In this way, the differing behavioral patterns of each income group are contrasted.

The theoretical model in this study ties the fiscal sector to the traditional models of residential location. Within this framework, both the Tiebout hypothesis and the effects of metropolitan consolidation are examined. An important conclusion from this analysis is that it is optimal for upper income households to locate in the central city under certain conditions, despite fiscal advantages and greater neighborhood amenities in the suburbs. The utility function provides an important link between accessibility models of residential location and the local government sector.

Significant results can also be drawn from the empirical model. First, the determinants of residential location were found to vary substantially by income groups. Second, the Tiebout hypothesis may not be valid in all metropolitan areas. This finding comes directly from the subsample regressions, and it further implies that cross-section models are not sufficient for analyzing a dynamic process such as residential location.

The goal of the consolidation simulation was to obtain an estimate of the response of households to the elimination of metropolitan fiscal variations. The results suggest that consolidation may have substantial effects on household location. This provides support for the Tiebout hypothesis. However, since the simulation assumed perfect mobility and instantaneous adjustment, the magnitude of the response was much too large.

DEDICATION

TO MY WIFE AND PARENTS

CHAPTER 1

INTRODUCTION

1.1 Problem Statement

It has been argued that the flight of households to the suburbs has been a primary factor in the deterioration of the central city in some metropolitan areas. With the departure of the middle and upper income groups, the central city has become increasingly populated by the poor, who demand relatively larger public expenditures for social services, but who provide relatively smaller tax revenues. As the central city attempts to increase its tax revenues to finance these higher service demands, primarily through wealth taxes (property and income), there is an increased incentive for the remaining middle and upper income families to also relocate in the suburbs. Accordingly, there is an increased discrepancy between metropolitan core cities and their suburbs in the fiscal capacity to raise adequate revenue on the other.

One of the major causes of this metropolitan fiscal imbalance against the central city is the requirements of poverty-related services. Woo Sik Kee (NTJ, 1968) found that metropolitan areas with large city expenditures for such services had substantial differentials in their general revenue requirements and tax effort between the city and the suburbs. The sample consisted of the 22 largest SMSAs, 13 of which are located in the north and east. Since these older and

declining central cities have been subject to decentralization trends for some time, the results found by Woo Sik Kee are not surprising.

This study will focus on the degree to which fiscal variations in a metropolitan area influence residential location. Although the decentralization process in metropolitan areas has been composed of both firms and households, the location of firms will be treated exogenously in this study. It is clear that firms also respond to changes in transportation costs and fiscal advantages. However, these parameters are assumed to differ between households and firms, and this study will concentrate on the determinants of household location.

Efforts to explain the impact of fiscal variations on household location have essentially resulted in the empirical testing of the Tiebout hypothesis (JPE, 1956). Given the assumptions of perfect mobility and knowledge, a large number of potential residential communities and the absence of external economies or diseconomies among communities, the Tiebout hypothesis states that an individual will locate in that community which provides the mix of public services and taxes best suited to his own tastes and preferences. In other words, the Tiebout hypothesis seeks to explain the phenomenon of "voting with one's feet" whereby individuals can gain fiscal advantages by their choice of residential location. It also incorporates location into the individual's utility maximizing behavior. Thus, it has been offered as a partial rationale for the suburban flight of the middle and upper income groups.

Given the fiscal dilemma of the central cities and the concurrent flight to the suburbs, several proposals have been made to mitigate the situation. Commonly cited solutions include a commuter tax, increased user charges, the shifting of financial responsibilities for poverty-

related services to higher levels of government and metropolitan governmental consolidation. The issue of metropolitan consolidation is undergoing widespread debate at present, and to date, consolidated governments have been instituted in six metropolitan areas: Miami, Florida; Jacksonville, Florida; Indianapolis, Indiana, Nashville, Tennessee; Lexington, Kentucky; and Anchorage, Alaska.

It is apparent that if residential location is in part determined by fiscal variations across a metropolitan area, then the implementation of a consolidated government can be expected to influence residential choice. The model developed in this study will analyze this issue, and it is important for two reasons. First, the study represents a direct test of the Tiebout hypothesis. Eliminating metropolitan fiscal disparities through the mechanism of governmental consolidation allows one to determine the sensitivity of residential location by comparing actual data with an *ex post* simulation. Second, it applies to a viable public Policy issue. Bish and Nourse (1975) point out that over 100 communities have studied the possibility of consolidated government in varying forms. However, if a metropolitan area chooses to implement governmental consolidation, it has little *a priori* knowledge of its effects on locational choice. This area certainly merits attention, particularly for its potential to alter the movement of households out of the central city.

The remainder of this chapter will elaborate upon the following points. First, the next section will analyze the arguments, both pro and con, on the issue of consolidation. Second, the empirical model will be briefly described. Last, an outline of the study will be presented.

1.2 The Issue of Metropolitan Government

The debate surrounding the issue of urban governmental organization has grown with the increasing movement of firms and households out of the core city and into the suburbs. As the responsibilities of local governments multiplied, the reform of local governmental structures became the central forcus for the resolution of the difficulties associated with both central city deterioration and suburban growth. The polar positions in this debate can be roughly categorized as those who favor consolidated governments and those who favor decentralized local governments. The arguments of each group can be quite vociferous. For example, Campbell and Burkhead (1968) state that the fragmentation of governments in metropolitan areas both mirrors and reinforces anarchy in urban areas. Alternatively, Warren (JAIP, 1964) argues that the viability of decentralized governments has been distorted and greatly underestimated, whereas the expectations of benefits with respect to consolidated governments exceed what can be predicted on the basis of evidence. Although considerable information has been received since these statements were made, present debates mirror these positions, and the issue remains unresolved.

The proponents of consolidated government base their arguments on two factors: efficiency and equity. Increases in efficiency are assumed to be realized from the following source. It is believed that fragmented and overlapping jurisdictions result in an inefficient duplication of services. Therefore, a consolidated government would be able to take advantage of economies of scale in the provision of publicly provided goods and services, and lower unit costs could be achieved.

Bish and Ostrom (1973) point out that the efficiency argument rests on three critical assumptions. First, it assumes that large-scale public bureaucracies can obtain, process and utilize information on public needs and can produce and distribute public services more efficiently than smaller public units. Bish and Ostrom argue that the potential distortion and loss of information at each level of organization may preclude any efficiency gains. Second, the realization of scale ecomomies assumes that consumers' tastes and preferences with respect to public goods are similar, that all public goods are homogeneous and that uniform levels of all public goods and services should be provided throughout the metropolitan area. This is clearly a tenuous assumption. Third, proponents of consolidation assume that all public goods and services are sufficiently similar that they can be provided by the same organization. However, Hirsch (1968) suggests that economies of scale will vary greatly among different public goods and services.

This latter point is elaborated on by Warren. An advocate of decentralized local governments, Warren suggests that small governmental units can realize economies of scale by contracting external producers for specific public goods. In this situation, a community can negotiate for a given service level, and it permits the right to withdraw and utilize other options. Thus, there is a separation of the production and provision of public goods and services, and a quasi-market is established.

Unfortunately, however, there is a dearth of empirical information on the efficiency characteristics of consolidated governments. Although the efficiency argument is intuitively logical, it rests on some very restrictive assumptions. It is hoped that in the near future, as the present consolidated governments become entrenched, an effort will be

made to assess the benefits and costs of consolidation.

The belief that metropolitan consolidation will increase equity rests on the assumption that the suburbs are somehow exploiting the central city. This can result from two sources. First, suburban commuters (workers and shoppers) are viewed as consuming central city goods and services while avoiding the full burden of taxation for them. Therefore, the suburban commuters, who are predominantly middle and upper income groups, are essentially subsidized by the central city. Second, it is assumed that suburban residents do not pay their equitable portion of poverty-related services, which are alleged to be metropolitan in nature. Thus, middle and upper income families who move to the suburbs are able to avoid this tax burden.

The first point has been analyzed in several studies. Woo Sik Kee reached the conclusion that commuters only partially offset the costs that they impose on central cities. He states that central cities with a large number of commuters must increase both expenditures and tax effort, which implies a larger degree of exploitation for these cities. However, these results are in contrast to those of Vincent (1971). Using a cross-section, recursive econometric model, Vincent's study suggests that commuters pay more in terms of central city taxes than they receive in central city services. Vincent's model estimated the impact of both commuting shoppers and workers on selected central city expenditures and revenues. He was able to derive the benefits and costs from the estimated coefficients for the workers and shoppers, and they indicate that exploitation does not exist in this respect.

The question of poverty-related exploitation has been much more difficult to analyze. Neenan (NTJ, 1970; Greene *et al.*, 1974) has

studied this problem in the Detroit and Washington, D.C. metropolitan areas. Neenan utilizes two concepts to allocate expenditures between the central city and the suburbs: the cost of service and the willingness to pay. The cost of service method allocates expenditures on a dollar basis to specific locations. The second method allocates benefits from government services according to a willingness to pay index, which is based primarily on the income distribution of the area. For example, upper income groups in the suburbs are assumed to have a willingness to pay value in excess of the allocated cost of service. Although this methodology has received some criticism (Brown, NTJ, 1971), Neenan found that exploitation does not exist on a cost of service basis. This result is reversed if the willingness to pay index is used. Therefore, definitive statements on this issue must be qualified despite the rigorous examination of specific metropolitan areas.

Given the indeterminancy of the efficiency and equity issues, the grounds for imposing consolidated governments appear to be questionable. Nevertheless, consolidation continues to draw considerable interest in all sections of the nation. For example, in June, 1971, over 125 metropolitan areas in 35 states were studying the issue (ACIR, 1972).

In addition, a basic question is to determine under what conditions consolidation will take place. Rosenbaum and Henderson (Journal of Politics, 1972) suggest that since consolidation represents a radical change in the urban environment, then the basic causes are analogous to those accompanied by revolutions at the national level. An example would include a situation of social disequilibriumand an inadequate governmental policy, which is followed by power deflation and radical change in the local political structure (e.g. consolidation). The relevance of this scenario is subject to doubt, but consolidation

is an extreme step. Cowing and Holtmann (Land Econ., 1974), who studied the distributional impact of consolidating welfare services in Binghamton-Broome County, New York, state that local consolidation initiatives depend on the distribution of gainers and losers between the central city and the suburbs. However, institutional processes vary from state to state, and consolidated government can also be the province of state legislatures.

This study will not be concerned with these normative aspects of the issue of metropolitan consolidation. Each metropolitan area contains unique characteristics, and it is beyond the state of the art to make definitive statements regarding the viability of consolidated government except on a case by case basis. Therefore, the primary goal of this study is to determine the impact of metropolitan governmental consolidation on residential location within the metropolitan area. It is hypothesized that consolidation would eliminate fiscal variations between the central city and the suburbs, and that household location would be influenced. This hypothesis is contingent upon two assumptions. First, households are assumed to derive a fiscal advantage by their choice of location. Second, this fiscal advantage is assumed to be a significant variable with respect to residential preferences. It is expected that fiscal advantages are but one of several determinants of location. Others include the quality of neighborhoods and job location. The following section will briefly describe the methodology which is used in this study.

1.3 Proposed Methodology

The model in this study will focus on middle class residential location. It is assumed that this income group represents the primary

component of the decentralization trend. It is hypothesized that this group will react to the Tiebout forces, which are discussed in section 2.1. The determinants of middle class location will also be used to estimate the location of upper and lower income groups. In this way, the differing behavioral patterns of each income group can be contrasted.

Since consolidation typically takes place between a central city and its surrounding county, cities which are part of more than one county will be excluded from the sample. The land area that a central city occupies within a given county will vary greatly. Therefore, the endogenous variable for the location equations will be constructed as an index, which, for the middle class, takes the form of $\frac{MS/PS}{MC/PC}$ where:

MS = the number of middle class families in the suburbs

PS = total number of families in the suburbs

MC = the number of middle class families in the city

PC = total number of families in the city

This index will provide insight into the relative density of each income group. A value greater than one implies that an income group is relatively more concentrated in the suburbs.

This study utilizes cross-section data, and the sample comprises 50 metropolitan areas. With the exception of fiscal data which is lagged three years, the data is taken from the 1970 census year. However, since location is expected to be sensitive to decentralization processes, a proxy for the movement of firms will be constructed.

The measure of fiscal variation is endogenous within the model, and the equation system will be estimated with two-stage least squares. The fiscal variation will be calculated as an identity of the ratio of per capita expenditures divided by per capita local revenues for the

suburb and city respectively. Each of the components of this measure will be estimated separately.

Although the residential location equations will be estimated for the entire sample, considerable insights will be gained by the use of a stratified sample to capture any variation due to regional factors. Specifically, central cities with positive growth, which are concentrated in the south and west, will be contrasted with cities which had negative population growth, primarily in the north and east. Therefore, it will be possible to determine if the type of city has a significant influence on location.

The potential impact of consolidation will be evaluated by a simulation technique. When consolidation is assumed to take place, the major influence of fiscal variation will be eliminated from the model. This implies that services and tax rates will be equalized throughout the consolidated area. Two assumptions are required. First, movement over space is assumed to be frictionless. For example, a household that locates one block away from a fire station will not receive better service than a household which is located several blocks away. Second, service quality differentials are assumed to be insignificant after a simulated consolidation. The effects of space and service quality are clearly not measurable. These complications do not invalidate the model because the measure of fiscal variation is developed in purely monetary terms.

The Tiebout hypothesis will be tested within this simulation framework. It is generally recognized that fiscal advantages have been partially responsible for the exodus to the suburbs, but this may not be true for all metropolitan areas. If a consolidated government is

implemented in a metropolitan area, a monetary fiscal advantage would disappear. Therefore, it is expected that household location would be determined by accessibility and neighborhood quality following consolidation. Any simulated movements would bear directly on the Tiebout hypothesis. It should be noted that this procedure violates Tiebout's assumption of a number of communities with varying tax-service mixes. This model assumes a homogeneous suburb which is contrasted with the central city. Although this assumption is somewhat unrealistic, it is necessary due to data limitations. Movements between core cities and the suburbs are assumed to be of more critical importance than movements between suburban communities.

1.4 Outline of the Study

The next chapter presents a rather lengthy literature review on the Tiebout hypothesis and the determinants of local government expenditures and revenues. The Tiebout hypothesis has undergone substantial theoretical and empirical revisions, and these will be examined in depth. Since the components of the measure of fiscal variation in this study are estimated separately, the proper specification of these equations is essential. The literature on local government expenditures and revenues therefore becomes quite important.

In Chapter 3, a model will be developed which incorporates fiscal variables into traditional residential location theory. Using comparative static analysis, it becomes possible to determine the location of households with different incomes. In addition, the impact of metropolitan consolidation can be analyzed within this framework.

Chapter 4 will present the empirical model which is composed of

nine equations. This model will be estimated for the entire sample, declining central cities and growing central cities. Considerable insight will be gained across both income groups and regions. These results will be summarized in Chapter 5, and they will be placed in the context of the Tiebout and consolidation literature.

CHAPTER 2

REVIEW OF THE LITERATURE

This chapter will review the literature on the relation of fiscal variables to residential location. This literature is composed of two parts. The first section will analyze the Tiebout hypothesis, its theoretical extensions and related empirical studies. The second section will examine the literature on revenue and expenditure functions for metropolitan areas. Both strands of literature are essential for this study on the impact of metropolitan consolidation on fiscal variables which may affect residential location.

2.1 The Tiebout Model

2.11 Introduction

The Tiebout model is an important theoretical construct in the field of urban public finance. Initially published in 1956 in response to Samuelson's exposition on the theory of public goods (Restat., 1954, 1955), the Tiebout hypothesis has been the subject of both theoretical revision and empirical research. Although the model explicitly considers neither central cities nor metropolitan areas, it is often considered as a point of departure in the investigation of urban fiscal problems. Mills and Oates (1975) provide an apt description of the theoretical power of the model. They state that substantial questions must be resolved with respect to the degree to which Tiebout forces operate in the local public sector. Unquestionably, however, the process which Tiebout envisioned possesses both considerable descriptive power and important but controversial implications. Thus, Mills and Oates conclude that the

model can be characterized in terms of remarkable theoretical insightfulness and unresolved empirical issues.

The analysis of the Tiebout hypothesis will be done in the following manner. First, the following section will evaluate the model as it was originally set forth. In the next section the theoretical revisions of the model will be discussed. Although the original paper was published twenty years ago, important clarifications have been formulated only relatively recently. However, these revisions add insight by incorporating issues such as residential location theory, and the theory of public goods and urban fiscal trends which have been developed to a far greater degree since the time of the original publication. Finally, the third section will analyze the strengths and weaknesses of the empirical tests on the Tiebout hypothesis.

2.12 The Tiebout Model

In his pioneering work, Samuelson derived the conditions for the optimal provision of public goods. More precisely, he demonstrated that public goods are characterized by jointness in consumption. Therefore, the total demand for a public good is determined by the vertical summation of individual demand curves. In contrast, the market demand for a private good is derived by the horizontal summation of individual demand curves. Mathematically, the Pareto optimal condition for public goods is represented by:

$$\frac{\partial U^A/\partial X_p}{\partial U^A/\partial X_r} + \frac{\partial U^B/\partial X_p}{\partial U^B/\partial X_r} = \frac{\partial F/\partial X_p}{\partial F/\partial X_r} \text{ or } \Sigma\, \text{MRS} = \text{MRT where}$$

A and B are individuals

X_p = a public good

X_r = private good numeraire

F = an implicit production function, $F(X_p, X_r)$

Using the same notation, the corresponding Pareto optimal condition for private goods is:

$$\frac{\partial U^A/\partial X_g}{\partial U^A/\partial X_r} = \frac{\partial U^B/\partial X_g}{\partial U^B/\partial X_r} = \frac{\partial F/\partial X_g}{\partial F/\partial X_r} \text{ where } X_g \text{ is also a private good.}$$

Thus, the property of jointness implies that price responds to a constant quantity (which everyone may consume) in the pure public good case, whereas quantity varies with respect to a given price in terms of private goods, assuming perfect competition.

The ramifications of Samuelson's work are far-reaching. The jointness property of pure public goods implies that the marginal cost to an additional consumer is zero. Accordingly, consumers have incentive to engage in strategic bargaining by understating their true preferences. Therefore, the individual demand curves are in essence "pseudo" demand curves, and the lack of revealed preference on the part of consumers will produce a nonoptimal provision of public goods. In essence, public goods represent one type of market failure.

Tiebout sought to prove that efficiency conditions could be met in the local public sector, and he separated himself from Samuelson by stating that the latter implicitly assumed that public expenditure decisions are made at the central government level. This represents an error by Tiebout. The issue with respect to Samuelsonian public goods is not their provision through public rather than private means, nor is the inability to exclude consumers either a necessary or sufficient condition with respect to pure public goods. Thus, Samuelsonian public goods are a consumption phenomena. Alternatively, Tiebout derived conditions for

the efficient provision of local publicly provided goods, and he mentioned such examples as police protection and education which are not pure public goods in the Samuelsonian sense.

Tiebout's model rests on the following assumptions:

1. Consumers are fully mobile, and they will move to the community which best satisfies their preferences in terms of publicly provided goods.

2. Consumers have perfect knowledge with respect to the revenues and expenditures which are set in each community.

3. There are a large number of communities in which to reside.

4. The sole source of income is dividend income. Therefore, the influences of job location are eliminated.

5. The publicly provided goods are characterized by the absence of external economies and diseconomies between communities.

6. Optimum city size is defined as the number of residents for which the bundle of publicly provided goods can be produced at the minimum average cost.

7. Communities below the optimum size will try to attract residents, and those above will try to reduce their population. A community which is at the optimum size can maintain its status by enacting zoning laws.

Given these assumptions, jurisdictional mobility on the part of consumers will produce an efficient allocation of resources in the local public sector. The greater the diversity between communities in terms of tax-service mix, the more likely the consumer will be able to locate in an area which closely approximates his tastes and preferences. Therefore, consumers are forced to reveal their preference by locational choice, and efficiency results when each community achieves its optimum size.

Tiebout mentions a number of difficulties with his model. First, consumers move to the community which best satisfy their preferences. However, if preferences were to be exactly satisfied, then there could conceivably be an infinite number of communities. Second, some of the assumptions are quite unrealistic. For example, moving is not costless, and perfect knowledge is unlikely.

The assumption that external economies and diseconomies are absent limits the application of the Tiebout model to Samuelson's theory of public goods. Tiebout assumes that the joint consumption characteristic of local public goods is internalized within each community. Since this is not the case, the Tiebout model is only peripherally related to Samuelson's work. This point will be developed further in the following section.

Although the Tiebout hypothesis does contain several restrictive assumptions, it is a conceptual solution to the efficient provision of local publicly provided goods. With respect to policy implications, it presents a strong challenge to the proponents of metropolitan consolidation, who generally believe that centralization will produce greater efficiency in local public goods provision. However, Tiebout efficiency requires segregation according to the tastes and preferences of consumers. The determinants and implications of this jurisdictional segregation will also be discussed in the following section.

2.13 Theoretical Revisions

Three important theoretical revisions will be analyzed in this section. First, Buchanan and Goetz (Journal of Public Economics, 1972) argue that the nonappropriability of locally provided public goods, as well as the locational dimension of both public and private goods,

places severe limits on the efficiency of the Tiebout model. The second area to be explored is related to the efficiency of the property tax as a pricing mechanism within the Tiebout framework. Hamilton (Urban Studies, 1975) and Hirsch and Margolis (1976) present contrasting results in their analyses. Finally, the distributional implications of the Tiebout hypothesis will also be discussed. Mills and Oates (1975) are the primary contributors in this area. Empirical studies related to these issues will be analyzed in section 2.14.

Buchanan and Goetz

Buchanan and Goetz attempt to prove that inefficiencies are inherent in the Tiebout model even in this conceptual form. In their view, Tiebout sought to describe a nonspatial adjustment process which would achieve a Pareto optimal solution through the formation of voluntary clubs. In this scenario, locational constraints do not exist. Accordingly, Buchanan and Goetz argue that if gains from trade can be secured from either the consumption or production side, then these gains will be exploited by the participants until the gains are exhausted. Buchanan and Goetz allude to Tiebout's assumption of dividend income as evidence of the latter's nonspatial analysis. Within the Tiebout framework, therefore, migration is neither a necessary nor sufficient condition for optimality, and location by consumers (club members) would be independent of the allocation of resources in the public sector. Thus, the model enables the individual to locate in space strictly on the basis of individual productivity criteria in the private sector. The club which he chooses is independent of this decision.

However, local governments contain spatial properties in addition to "membership" dimensions. Furthermore, resources are not ubiquitous

in the private sector across any given area. Using the notation of Buchanan and Goetz, the necessary conditions for Pareto optimality are: $MVP^i_x + MVG^i_x = MVP^i_y + MVG^i_y$ where i refers to individuals, x and y refers to two communities and MVP and MVG represents the marginal value product of private and public goods, respectively. To a potential migrant, the optimality conditions will be expanded to:

$$MVP^i_x + (B^i_x - T^i_x) + [\frac{\partial(\Sigma B^J)}{\partial N_x} - \frac{\partial(\Sigma T^J)}{\partial N_x}]$$

$$= MVP^i_y + (B^i_y - T^i_y) + [\frac{\partial(\Sigma B^J)}{\partial N_y} - \frac{\partial(\Sigma T^J)}{\partial N_y}]$$

where $i, j = 1,2,\ldots,N \quad i \neq j$

N = number of persons in a community

B = benefits received from the public good by the individual

T = taxes paid by the individual

$B^i - T^i$ = fiscal residuum to the individual.

Given the assumption that both communities produce the same quality of a Samuelsonian pure public good, the model will produce a Pareto optimal solution. The joint consumption characteristic implies that:

$$\frac{\partial(\Sigma B^J_x)}{\partial N_x} = \frac{\partial(\Sigma B^J_y)}{\partial N_y} = 0 \ .$$

The corresponding tax shares are:

$$T^i_x = \frac{\partial(\Sigma T^J_x)}{\partial N_x} \ , \ T^i_y = \frac{\partial(\Sigma T^J_y)}{\partial N_y} \ .$$

Therefore, the optimality condition reduces to $MVP^i_x = MVP^i_y$. However, this model is incorrect in the sense that individuals will have no incentive to reveal their true preferences. Moreover, this is not a model of mobility-induced efficiency because the marginal cost to an additional resident is zero.

The most glaring weakness in the Tiebout model is the assumption that private returns are equalized across communities. For example, suppose that fiscally-induced migration can equalize the fiscal residuum between communities for a given income group. However, if $MVP_x \neq MVP_y$, then a nonoptimal solution is reached. This is the result of locational constraints in relation to the private sector, whereby a differential locational rent is earned across communities. The migration that results will equalize MVP_x and MVP_y, but there will be an over-concentration of residents in the more productive community. Therefore, $N_x \neq N_y$ is necessary for $MVP_x = MVP_y$. The ultimate result is that public services will not be provided at minimum average cost. Tiebout's assumption of dividend income is overly restrictive and unrealistic.

A similar nonoptimal result is reached if "impure" public goods are considered. For example, local publicly provided goods are not equivalent to Samuelson's definition of public goods. Therefore, a migrant will impose congestion costs ($MC \neq 0$) on the community to which he moves. Mathematically, this is represented as:

$$\frac{dB^J}{dN} = \left(\frac{\partial B^J}{\partial Q}\,\frac{dQ}{dN}\right) + \frac{\partial B^J}{\partial N} \quad \text{where Q is the quantity of the public good.}$$

If congestion is present, then it is likely that $\frac{\partial B^J}{\partial N} < 0$. The total effect $\left(\frac{dB^J}{dN}\right)$ will be negative if the effect of congestion is greater than the increased cost-sharing of the tax burden. In other words, dQ/N will be negative if the price effect due to the increased cost-sharing is less than the downward shift in the marginal evaluation schedules as the good becomes more congested. Mobility would be likely to produce disequilibrium in the public sector.

In summary, Buchanan and Goetz conclude that the Tiebout model is not a market analogue to the private sector. Essentially, the model is limited in two respects. First, locational constraints enter into both

the private (locational rents) and the public (congestion) sectors. Second, there is the problem associated with determining the marginal evaluation by individuals of both pure public goods and local (impure) public goods. Therefore, the use of the Tiebout hypothesis as an efficiency benchmark is severely limited.

Hamilton

Hamilton argues that an efficiency mechanism does operate within the Tiebout model. He suggests that the major failure of Tiebout was his failure to devise a system of prices which would operate within the equilibrating mechanism (mobility). Hamilton's model contains two basic assumptions. First, a proportional property tax is the sole source of revenue, and the effective rates may vary between communities. Second, each community has a zoning ordinance which sets a minimum level of housing consumption for all residents within the community. Given these assumptions, Hamilton derives the following results. First, Tiebout efficiency will be maintained in the provision of local public goods. Second, the property tax becomes an efficient pricing mechanism which does not impose an excess burden between housing consumption and other goods. Third, local governments cannot engage in income redistribution. Finally, it is shown that neither taxes nor public expenditures are capitalized into property values.

Every household in Hamilton's model has the utility function:

$U = U(X_1, X_2, X_3)$ where

X_1 = per family consumption of housing

X_2 = per family consumption of local public goods

X_3 = per family consumption of composite private commodity bundle

Both X_1 and X_2 as well as the property tax rate can vary among communities, but they must be constant within communities. The zoning restriction

requires that each resident in community i must consume at least X_{1i} of housing. The constraint faced by the consumer is: $Y = P_1X_1 + P_2X_2 + P_3X_3$, and maximizing utility subject to the constraint yields the household's optimum commodity bundle (X_1^*, X_2^*, X_3^*). Accordingly, the household's optimum location will be in that community where X_1^* equals the zoning restriction X_{1i}. He cannot reside in a community where $X_1^* < X_{1i}$. Furthermore, if he lives in a community where $X_1^* > X_{1i}$, he can either increase his consumption of X_2 or reduce his tax price by moving to that community where $X_1^* = X_{1i}$. Therefore, each community is characterized by X_1', X_2', and a sufficient number of communities would insure a market analogue in the public sector. The property tax becomes an efficient pricing mechanism because the tax price is independent of all goods with the exception of X_2', and accordingly, it carries no deadweight loss. For any given tax payment, housing consumption can be varied without the consumer bearing any capitalization in terms of P_1. Thus, the property tax is perceived only in terms of local public goods received, and it essentially becomes a head tax with no distortion on prices.

Hamilton extends his model to include non-optimal states. First, if there is an excess demand for housing within a given jurisdiction, the value of the land will be bid up, and an economic rent will be earned by landlords. This type of capitalization will be discussed in the following section. Second, there are difficulties associated with the joint consumption characteristic of public goods. This was discussed previously. Third, the production functions for local public goods are not known. For example, the measurement of public outputs is an extremely arbitrary task. Therefore, pricing at minimum average cost represents a purely normative statement. Thus, considerable doubt can

be cast on Tiebout efficiency within Hamilton's theoretical framework.

Hamilton (1975) tests the efficiency of the property tax in the following manner. His hypothesis states that central city residents regard the property tax as a component of the price of housing, whereas suburbanites do not. In other words, Tiebout efficiency exists in the suburbs, but not in the central city. The equation to be estimated takes the form of:

$$\ln(V) = \ln(C) + \beta \ln(Y) + \alpha \ln(F) + Cu \ln(U) + C_D D$$

where

V = house value

C = a constant

Y = family income

β = income elasticity of the demand for housing

F = family size

U = distance from CBD

D = dummy variable, 1 = city 0 = suburbs

The model was estimated for fifteen SMSA's using 1960 census data.

Hamilton argues that if the property tax is regarded by suburbanites as a benefit tax for local public goods and services, then they will consume more housing. Assuming a price elasticity of demand for housing equal to negative one, Hamilton calculates a predicted value of $C_D = -.135$. Four of the SMSA's were eliminated from the sample because they had three or less school districts. Thus, they were not representative of a Tiebout framework which allows for sufficient diversity in the provision of public goods. Of those remaining, ten of the eleven SMSA's had negative values for C_D, and the mean value was -.132. Therefore, Hamilton viewed his hypothesis as verified.

However, there are several difficulties with his hedonic price model. First, the t-statistics for C_D are quite low in most cases. Therefore, the standard error of the coefficients is likely to be large. Second, (U) is used as a proxy for the price of housing, but it represents accessibility which is but one component of housing services. In addition, Cu was generally insignificant. Finally, it is possible that C_D captures amenity and environmental characteristics, and that these effects are responsible for the result obtained by Hamilton. Therefore, the efficiency of the property tax is not verified within this model.

Hirsch and Margolis

Hirsch and Margolis suggest several difficulties inherent in the Tiebout model. Specifically, they mention the problem of locational constraints and the variability of expenditures and revenues in a community, which Tiebout viewed as fixed. However, their primary concern is to demonstrate that the property tax is an inefficient pricing mechanism which does impose an excess burden.

Utilizing normal rent-bid curve analysis, they state that parcels of land will go to the highest bidder. The model includes the following assumptions. First, employment is located in a CBD. Second, there are two communities _a_ and _b_, with _a_ located nearer to the CBD. Third, there are two builders who construct apartments and housing respectively. Fourth, the same number of commuters emanate from each area (m). Commuting costs for _a_ and _b_ are denoted by C_a and C_b respectively. Therefore, the locational rent that apartment builders will pay for _a_ is greater than that for house builders because apartment density is greater than household density ($d_1 > d_2$). The differential is shown

as $d_1m\ (C_b - C_a) > d_2m\ (C_b - C_a)$. This result duplicates the usual rent-bid analysis.

The imposition of a property tax introduces two distortions. First, the locational tendency described above is reversed in the presence of a property tax. This result rests on the conclusion that property value per house is lower in b than a, and that the structure value per acre is greater for apartments than for single family housing. Both represent realistic assumptions. Mathematically, the condition for locational reversal is shown as: $d_1S_1(t_a - t_b) > d_2S_2(t_a - t_b)$ where

S_1 = structure value of apartments

S_2 = structure value of houses

t_a = effective tax rate in a

t_b = effective tax rate in b

Therefore, since the property tax is not a general tax on capital due to exemptions and varying rates, a substitution between locations occurs.

The property tax also introduces an additional distortion. Hirsch and Margolis assume diminishing returns with respect to the provision of public goods. Assuming increasing costs, if a household that consumes less than the average housing moves into a community, it will impose costs on the rest of the residents. This is denoted by:

$\frac{\partial C}{\partial N} > t\ V_i$ where

C = cost of government

N = number of residents

t = effective tax rate

V_i = housing value of i^{th} resident

This transfer of costs implies that the property tax redistributes income from the rich to the poor, and that all new residents should build housing of lower value than the community average. However, old residents have three options. First, they can lessen their consumption of housing by reducing maintenance expenditures. Second, they can move to another community. Third, they can impose zoning restrictions.

This conclusion has substantial implications with respect to the deterioration of residential areas. Hirsch and Margolis also demonstrate that in the absence of zoning regulations (Hamilton), the property tax is an inefficient pricing mechanism. Therefore, Tiebout efficiency is further questioned. However, Hirsch and Margolis provide support for Hamilton's position that redistribution is inefficient at the local level. Since the rich are mobile, segregation by income classes becomes a distinct possibility. This point will be discussed below.

Mills and Oates

Mills and Oates (1975) analyze the distributional implications of the Tiebout model. For example, if the mix of public services within a community is partially determined by income levels, then the Tiebout model implies that communities will be segregated by income. This view is consistent with the results obtained by Hamilton and Hirsch and Margolis.

It was noted in the previous discussion that there are incentives for households with low housing consumption to enter wealthier communities. If the property tax is equivalent to housing consumption, these migrants will not bear the marginal cost of the local public goods, and consequently, part of the costs are shifted onto the old residents. This phenomenon is the rationale for the type of fiscal zoning which was suggested by Hamilton. However, Mills and Oates suggest that another form of zoning

may also exist, and they refer to it as public goods zoning. In this situation,old residents try to control the characteristics of in-migrants, and by doing so, the community achieves a desired level of public goods output. For an example, consider the case of police protection. Mills and Oates argue that a low level of crime (the output of police protection) can be achieved in a community which is populated by upper income residents rather than the poor. Therefore, public goods zoning represents an alternative means to obtain revealed preference in the public sector.

Mills and Oates further argue that the Tiebout model applies only to suburbs and not the central city. Because the poor lack mobility, they are stranded as a residual in the central city. Thus, the Tiebout model is consistent with patterns of decentralization in urban areas. This implies that local redistribution efforts will be unsuccessful, and exclusionary zoning will enable the rich to gain greater efficiency in public goods provision. However, Mills and Oates suggest that higher incomes, cheaper means of transportation and FHA policies are primarily responsible for exclusionary suburbs. Tiebout processes merely represent another constraint on housing location, which may produce greater decentralization. Furthermore, they state that people may live and work in places other than where they would reside if a metropolitan government was implemented. This latter point represents the hypothesis of this study.

The theoretical revisions which have been analyzed in this section have made important contributions to the understanding of the Tiebout hypothesis. First, Tiebout efficiency is achieved only under extremely restrictive conditions (zoning). Buchanan and Goetz point out that the Tiebout model can be efficient only in a nonspatial context. Second, it is unlikely that the property tax acts as an efficient pricing

mechanism in the public sector. Hamilton's theoretical model is somewhat simplistic, and the regression which he estimates to support his theory contains glaring errors. Third, Tiebout processes are a contributing factor to the decentralization of urban areas. Therefore, although the Tiebout model is limited in its usefulness relative to the optimal provision of local public goods and services, it remains an important empirical hypothesis to test the effects of fiscal variations on household location within metropolitan areas. The following section will analyze some of the empirical models which have dealt with the Tiebout hypothesis.

2.14 Empirical Studies on the Tiebout Hypothesis

Empirical research on the Tiebout hypothesis has centered on the degree to which Tiebout forces operate in the local public sector. Two basic approaches have been pursued. First, Oates (JPE, 1969) stated that the relative attractiveness of a community with respect to local public expenditures and taxes will be capitalized in the property values of a given community. The methodology of Oates was duplicated by Edel and Sclar (JPE, 1974), who incorporated time-series analysis into the model. In addition, this methodology was the subject of considerable criticism by Pollakowski (JPE, 1973), to which Oates replied (JPE, 1973). This debate will be analyzed in considerable depth.

The second approach is primarily centered on the influence of fiscal variations within a metropolitan area on the location of residences in the central city *vis-a-vis* the suburbs. A fiscal residuum was utilized as the measure of fiscal variation in studies by Aronson and Schwartz (NTJ, 1973) and Bradford and Kelejian (JPE, 1973). Haurin and Tolley (1976) use the concept of a fiscal externality to measure the welfare losses of nonoptimal residential location. These empirical

studies suggest that the original intent of the Tiebout model has been all but discarded. Tiebout's response to the Samuelsonian theory of public goods has been largely ignored. However, empirical research has transformed the Tiebout hypothesis into a model which seeks to explain the impact of local fiscal variations on locational choice. Therefore, the strength of the model is its theoretical flexibility, and its insights remain formidable in light of recent urban trends.

Oates and his Critics

Oates' study represents the major paper in terms of the empirical research on the Tiebout hypothesis. First, Oates assumes that individuals' residential location is at least partially determined by the tax-expenditure mix across communities. Second, he argues that property values would be bid up in those communities which have a more attractive tax-expenditure mix. Therefore, capitalized property values were viewed by Oates as evidence that Tiebout forces exist. Third, Oates states that the coefficients of the tax-expenditure variables in his econometric model would indicate the degree to which the Tiebout hypothesis operates.

Oates utilizes cross-section data, and his sample consists of fifty-three municipalities in New Jersey which are located within the New York City metropolitan area. In addition to tax-expenditure variables, Oates includes housing quality, income characteristics and accessibility to New York in order to account for neighborhood quality, population factors and commuting time, respectively. The specified form of the model is:

$V = f(T,E,M,R,N,Y,P)$ where

V = median home value in thousands of dollars

T = the effective percentage tax rate

E = per pupil expenditures for education

M = linear distance of the community to New York

R = median number of rooms per owner-occupied house

N = percentage of houses built in the previous decade

Y = median family income in thousands of dollars

P = percentage of families with an income of less than $3,000

Each of the right-hand variables were converted into natural logs, and the equation was estimated by both ordinary least squares and two-stage least squares. Possible specification errors and other econometric problems will be evaluated in relation to Pollakowski's analysis.

The results obtained from OLSQ and TSLS did not differ significantly. Oates' rationale for employing TSLS was to adjust for a possible simultaneous equation bias between the tax and expenditure variables. The estimated coefficient for the tax variable was -3.6 in both equations, whereas the value for the expenditure proxy (education) was 3.2 and 4.9 for the OLSQ and TSLS regressions, respectively. Using these values, Oates found that the capitalization of education would offset approximately two-thirds of a capitalized increase in the effective property tax rate of from two to three percent, assuming a home with a value of $20,000, an expected life of forty years and a discount rate of five percent. However, Oates points out that increases in property tax rates unaccompanied by increases in public services will cause property values to be lowered in a given community. Therefore, if individuals do respond to fiscal variations, then income segregation by community is a distinct reality. For example, those communities which enforce some type of

fiscal zoning will be able to offer either a given level of public services at lower tax rates or a higher level of public goods at the same effective tax rate. One would expect that there would be higher rates of expenditure capitalization in such instances.

Hamilton (JPE, 1976) challenges the theoretical basis of the Oates model. He argues that the correlation between fiscal variables and property can be attributed to two factors. First, he suggests that there may be systematic differences in the production functions for raising revenues and/or providing public services across communities. Therefore, a household will pay a rent based on the nonreproducible efficiency of a local government. Second, he argues that capitalization may occur because of a disequilibrium in which there is a short-run shortage of "fiscal havens." For example, if the impact of rising incomes or net migration (such as the poor) causes a relative shortage of a particular type of community, then property values will rise in the relatively scarce communities. Therefore, capitalization will occur for any set of government activities which are in short supply, and it can include both "fiscal havens" and "fiscal slums." Moreover, Hamilton suggests that the results that Oates obtained from his sample are not reproducible using other samples.

The supply disequilibrium aspect of Hamilton's comments were empirically tested by Edel and Sclar within the framework of Oates' model. Although Oates' conclusions appear to suggest that individuals do respond to local fiscal variations, Edel and Sclar argue that he failed to include supply conditions into his model. Furthermore, they state that Oates discovered the presence of a Tiebout disequilibrium. If a competitive equilibrium had been achieved, Edel and Sclar claim

that neither tax nor expenditure capitalization would have occurred. Finally, they point out that the Tiebout hypothesis may be valid only in terms of particular local public goods and services rather than public expenditures in the aggregate. Therefore, Edel and Sclar seek to reintroduce the efficiency aspect of the Tiebout model into Oates' methodology. Declining tax-expenditure capitalization over time would be evidence that a metropolitan area was approaching a Tiebout equilibrium. However, one should recall the restrictiveness of Tiebout's assumptions. The absence of capitalization could result from consumer indifference between services and taxes, imperfect knowledge of local tax-service mixes or restricted mobility. These conditions may also be changing over time.

Edel and Sclar analyze the Boston area, and they estimate a cross-section equation for each of the census years 1930-70. The equation is specified as:

$V = f(T,D,O,E,H)$ where

V,T, and E have the same definitions as in Oates' model

D = population per square mile

O = percent of housing owner-occupied

H = highway maintenance (dollars per square mile)

Two other distinctions should be noted. First, the values of the right-hand variables were not normalized into log form. Second, Edel and Sclar do not state whether they employed OLSQ or TSLS.

However, their results suggest that OLSQ may have been utilized. For example, the coefficient for tax capitalization fluctuates greatly (from a value of -811 to -43.3), and it is not significant for 1930 and 1960. Moreover, school expenditures are not statistically significant in any year with the exception of 1950, and the signs are

negative for 1930 and 1940. In addition, highway expenditures also fail a t-test at the .01 level. Finally, the coefficient of determination is substantially lower in all years relative to Oates' regressions.

In spite of these conflicting results, Edel and Sclar argue that the smaller rates of capitalization are not evidence of indifference, but rather they indicate movement toward a Tiebout equilibrium for some public goods. For example, the estimated coefficient for education declined from 23.7 in 1950 to 1.99 in 1970. According to Edel and Sclar, this is illustrative of the effects of the post-war baby boom. Supply adjustments over time have reduced the capitalization of education to a point where a Tiebout equilibrium is approximated.

One can disagree with these results. If OLSQ was used to estimate the equations, then it contains a simultaneous equation bias. Not only are taxes and expenditures highly correlated, but property values are certainly a determinant of tax rates. Therefore, the coefficients of the parameters are both biased and inconsistent, and this can account for the insignificance of the variables as well as their lack of stability over time. If these econometric problems do in fact exist, any comparisons to the results obtained by Oates must be discounted. However, since Edel and Sclar neglect to discuss their estimation procedure, this line of reasoning may be inappropriate. Alternatively, one could question the realism of Tiebout's assumptions.

The contribution of Edel and Sclar rests with their use of cross-section data over consecutive census years. Unfortunately, the question of Tiebout efficiency remains unanswered. This is due to either econometric misspecification or the unrealistic assumptions of the

Tiebout model itself. Therefore, one must be skeptical of both the results derived and their interpretation in this model.

Oates was cognizant of the econometric problems which he faced. He stated that his results should be viewed as an order of magnitude rather than indicating a precise outcome. In his criticism of Oates, Pollakowski cites three major difficulties, and each will be analyzed in turn below. First, Oates' model may be seriously misspecified. Second, there is the possibility of relevant omitted variables. Third, the sample may reflect conditions which would increase the likelihood that the Tiebout hypothesis would be validated.

Pollakowski questions the use of median family income in Oates' model. Oates states that median family income serves as a proxy for neighborhood and environmental amenities. However, Pollakowski asserts that this variable artificially augments the explanatory power of the regression. For example, two-stage least squares is properly used when the stochastic right hand variables (T and E in this example) are regressed on exogenous variables which are correlated with T and E but uncorrelated with the error term. Since the error term most likely contains the intangible quality characteristics of a community, the use of median family income as an exogenous variable would add to rather than eliminate the simultaneous bias in the equation. Moreover, one could argue that a simultaneous equation system is required to eliminate the bias of Oates' regressions. For example, the impact of inter-governmental revenue is ignored in the model. Therefore, the expenditure and tax variables should be fully specified. This issue will be dealt with in section 2.2.

Second, Oates utilized per pupil educational expenditures as his proxy for the level of public services. However, Pollakowski asserts

that this technique neglects other components of the expenditure mix which may also influence property values. In effect, while Oates interpreted his results in terms of educational expenditures, he neglected to specify the relationship between education and other public expenditures. This specification error (the omission of relevant variables) will bias the coefficient of the education expenditure variable. The magnitude and direction of the bias will depend on the degree of correlation between the specified and omitted variable and the importance of the omitted variable in the regression. This can be denoted as: $\hat{\hat{\beta}}_i = \hat{\beta}_i + \alpha_{ij}\ \hat{\beta}_j$ where

$\hat{\hat{\beta}}_i$ = the estimated coefficient of the education variable

$\hat{\beta}_i$ = the estimated coefficient of the education variable with the omitted variable included in the regression

α_{ij} = the coefficient obtained by regressing the omitted variable on the education variable

$\hat{\beta}_j$ = the coefficient of the omitted variable

Therefore, Pollakowski states that Oates' interpretation of the results is valid only if other public services are not capitalized, and if the output of other public services is unrelated to the provision of education. Edel and Sclar suggest that the former may be realistic. However, the latter assumption is certainly not viable.

Finally, Pollakowski argues that Oates' sample produces biases of its own. For example, the Tiebout hypothesis assumes that mobility is not restricted in any way. However, although this may be valid for suburban communities, it is not for the poor residents of the central city. Therefore, Oates' choice of residential suburbs for his sample is likely to produce results which would seem to verify the Tiebout

hypothesis. Pollakowski states that this verification is valid only for the particular sample selected, and it is not applicable in a general context.

Pollakowski specified a model which incorporated these criticisms but yet was analogous to Oates' study, and it was tested in the San Francisco Bay area. His results suggest that extreme caution must be used in the interpretation of the estimated coefficients. However, this caveat was also made by Oates in his study. Therefore, although Pollakowski was able to elucidate some of the deficiencies of the Oates model, he failed to provide a method to improve it.

Oates' reply to Pollakowski was somewhat superficial. Admitting that the omission of other public expenditures did produce biased estimates, Oates reformulated his regression to include a variable for a composite public goods and services other than education. However, Oates defended his use of median family income by stating that this measure is suitable as a proxy for community intangibles, particularly since Pollakowski failed to provide a more reasonable measure.

This debate misses the point. The determinants of public expenditures, taxes and property values must be specified within the framework of a simultaneous equation system. Since this was not done, Oates is quite correct in qualifying the results of his model. Although Tiebout forces may indeed be realistic, the degree to which they operate cannot be determined on the basis of Oates' results.

It seems clear that testing for the presence of capitalization represents at best only an indirect means of depicting the movement of households which is implied by the Tiebout hypothesis. Therefore, it is more plausible, a priori, to develop a model in which fiscal

variations are more clearly developed, and in which residential location is determined by such variations. The following studies are based on this point.

Aronson and Schwartz

Aronson and Schwartz state that the purpose of their paper is to prove that a Tiebout equilibrium is dynamically unstable. This results from two factors. First, they argue that local taxes are based on income and wealth, and therefore, they do not represent a true benefit tax. Second, since there is an unequal distribution of income and wealth across communities, a motive exists for jurisdictional mobility which may be independent of an individual's tastes and preferences in terms of local public goods and services. Essentially, this reasoning is similar to that developed by Hamilton and Hirsch and Margolis, who found that in the absence of zoning restrictions, there is an incentive for the poor to migrate to areas with a higher tax base. According to Aronson and Schwartz, an individual will receive a positive fiscal residuum (benefits minus costs) in community *i* if his personal income is less than the per capita income of community *i*.

In terms of fiscal variables, the individual will try to maximize his fiscal residuum. It is assumed that taxes are based on income. Therefore migration will occur if the following condition holds:

$\Delta E > Y_x \, \Delta t$ where

ΔE = difference in two communities' per capita expenditures

Y_x = personal income of individual *x*

Δt = difference in two communities' tax rates

Indifference with respect to location will occur when $\Delta E = Y_x \, \Delta t$.

Therefore, a boundary line on their migration is $1/Y_x$ with the slope given by $\frac{\Delta t}{\Delta E}$. This slope approaches zero for those with high incomes relative to the community average, and these individuals will have incentive to relocate in any community which has a lower tax rate. Conversely, this slope will approach infinity for the poor, and they will relocate (assuming costless moves) in a community with higher per capita expenditures.

Equilibrium in this model would result when $FR_{xi} = FR_{xJ} = \ldots = FR_{xz}$, where FR is the fiscal residuum. This condition can only hold when tax rates, expenditures and per capita income are equalized across all communities. However, since income is not equally distributed, fiscally induced migration is likely to result in a widening of these disparities. For example, if a relatively poor migrant enters a community, then per capita expenditures would fall unless taxes are raised. Accordingly, the same result would occur if a relatively rich individual migrated away from the community. Therefore, a stable quasi-equilibrium can exist when the following restrictive conditions hold:

(1) only the poor are permitted to migrate.

(2) no vacant land exists.

(3) fiscal zoning is prohibited.

In their empirical analysis Aronson and Schwartz divide communities into potential origins and destinations. A destination community is defined as one which offers either higher per capita expenditures at an equivalent tax rate or equivalent per capita expenditures at a lower tax rate. Therefore, each town is an origin town, and potential destinations were determined by calculating the effective tax rate, per capita expenditures and thus the fiscal residuum for all communities. Their fiscal maps were computed for the census years 1950-70.

If the hypothesis is correct, then, *ceteris paribus*, the population of destination towns should increase relative to their origin towns. The result was determined by comparing the percentage change in the population of origin communities over a ten year period with that of destination towns. In the interval 1950-60 approximately sixty-nine percent of the migration went in the predicted direction. This increased to eighty-nine percent for the years 1960-70. Therefore, Aronson and Schwartz conclude that fiscal variations are important in the determination of residential choice within an urban area.

There are two major weaknesses in this study. First, the fiscal residuum does not deal with the expenditure mix of a community. Theoretically, the mix of publicly provided goods could change substantially without altering an individual's fiscal residuum. Second, this model ignores all other determinants of locational choice. For example, it was previously discussed that relatively wealthy communities can provide a given level of services at lower effective tax rates. It can also be expected that neighborhood amenities are closely correlated with the income of a community. Therefore, separating the effects of fiscal variations and other community characteristics with respect to locational choice are impossible within the framework of this model.

Bradford and Kelejian

A more sophisticated econometric approach is taken by Bradford and Kelejian. Since their model seeks to explain the determinants of the middle class exodus to the suburbs, it is relevant to the Tiebout hypothesis. Specifically, Bradford and Kelejian found that fiscal surplus differentials are important in explaining middle class location. Moreover, their model suggests that a degree of income segregation would

result from this process. The middle class will migrate to the suburbs, and the poor will be locked in a deteriorating central city.

Bradford and Kelejian hypothesize that the movement of middle class families to the suburbs is a "cumulative flight phenomenon." Therefore, a cycle is established by the increasing concentration of poor in the central city, middle class migration and the increased fiscal burden on those middle class families remaining in the central city. This implies that the incentives for migration will be increasing over time.

Bradford and Kelejian used cross-section data from the 1960 census year, and the sample consisted of eighty-seven of the most populated SMSA's in the country. Furthermore, they define the urban fringe (suburbs) to be the portion of land within the urbanized area which is outside of the central city boundary. The specification of the model is:

$$\frac{MC_i}{MU_i} = f(MFI,\ CONPOP_{T-10},\ MFISC_{T-3},\ F6MF5,\ \frac{PC20-}{POPC}) \text{ where:}$$

$\frac{MC_i}{MU_i}$ = middle class density in the central city

MFI = median family income in the urbanized area

$CONPOP_{T-10}$ = population density in the urbanized area lagged ten years

$MFISC_{T-3}$ = net fiscal surplus received by middle class families in the central city lagged 3 years

F6MF5 = a measure of the relative size of the central city to the urbanized area from 1950-60

$\frac{PC20-}{POPC}$ = percentage of poor in the central city

The equation was estimated with two-stage least squares, and MFISC was endogenous within the system.

Of central importance in this model is the role of the middle class fiscal residuum. Since this variable was significant and had the appropriate sign, Bradford and Kelejian are able to conclude that income redistribution efforts by central cities are self-defeating. Furthermore, they state that reductions in central city poverty could be expected to lure middle class families back to the central city.

This model is deficient in several respects. First, historical concentrations are used as a proxy for "natural" geography and the central city infrastructure. However, Bradford and Kelejian ignore the location of industry, arguing that the same determinants of residential location will determine job location. This is rather questionable reasoning. The decentralization of jobs may be the result of changing production functions of firms (land intensiveness) or of cost differentials (less expensive office space). Therefore, job location may represent an omitted relevant variable. Second, although the model does contain a variable for the relative size of the central city to the urban area, a more reasonable measure of middle class density could be $\frac{MS/POPS}{MC/POPC}$. A density index such as this may be more desirable because it would indicate middle class concentrations in the central city relative to the suburbs, rather than just a percentage. Moreover, it could better account for the problems of central city size. Third, the fiscal residuum (MFISC) is based on questionable assumptions. Implicitly, Bradford and Kelejian assume a constant marginal utility of government expenditures across all income classes coupled with a proportional tax for all nonpoor families. However, they assume that a nonpoor family in the city pays 2.5 times as much taxes than a poor family. Therefore,

$$MFISC = \left[\frac{\text{Government Expenditures}}{\text{Total Population}} - \frac{2.5\ (\text{Locally generated revenues})}{\#\ \text{poor} + 2.5\ (\#\ \text{non-poor})}\right].$$

This measure is inadequate for two reasons. First, it is based on inspection rather than economic theory. Bradford and Kelejian use Gillespie's (Musgrave, 1965) estimates of tax-expenditure incidence which is based on 1960 income data. Their multiplicative measure (2.5) is extremely arbitrary in the sense that it is based on an average nonpoor family. The failure to differentiate between middle and upper income groups introduces a bias in terms of the income distribution in a particular urban area. Second, a more appropriate measure would relate the fiscal residuum of central city middle class families to that in the suburbs. It is this differential which is the incentive for migration, and not the relationship of MFISC and the fiscal residuum for the poor in the central city only.

A fourth criticism is that Bradford and Kelejian state that race is not a significant determinant of middle class location. However, using the same data and sample, Parvin (JPE, 1975) introduced the percentage of nonwhites as an independent variable, and it was significant in the regression. Therefore, Parvin states that the scarcity of segregated areas in the central city is likely to increase the flight of the predominantly white middle class.

Despite these criticisms, Bradford and Kelejian do present results which are consistent with hypotheses previously discussed. First, income redistribution is an inappropriate task for local governments to engage in. Second, fiscal variations within a metropolitan area are likely to produce income segregation. Therefore, this study represents an important contribution to the verification that Tiebout forces do indeed operate in urban areas.

Haurin and Tolley

Haurin and Tolley attempted to explore the spatial and welfare implications of a fiscal externality within a metropolitan area. They utilize the phrase "fiscal externality" in the context of a distortion between benefits received and taxes paid with respect to public services. Their model is based on Hamilton, who argued that efficiency in the public sector is achieved in the suburbs but not in the central city. This result rests on the assumption that the property tax is a head tax in the suburbs, but that it carries an excess burden in the central city. For this to occur, the income of the residents for the city and suburbs must be heterogeneous and homogeneous, respectively. This distortion represents a violation of horizontal equity.

Haurin and Tolley develop a rather sophisticated mathematical exposition to analyze the welfare costs of the distortion cited above. First, they specify an individual utility function of housing, public goods and a composite private good. The budget constraint includes transportation costs, which increase with distance from a CBD. Each individual consumes the same amount of the public good, but the tax-price will vary because the public good is financed through the property tax. Second, a Cobb-Douglas production function (land and capital) for housing is specified, and a rent-bid function is derived. Next, the demand for housing is assumed to be a function of income and its price, and the price contains the capitalization of the fiscal variation between the central city and the suburbs. With respect to Hamilton's model, this is equivalent to a minimum zoning requirement that exists in the suburbs but not in the city. This is also consistent with the assumption of Bradford and Kelejian that the rich pay more than the poor for public services in the central city.

Although the mathematics will not be reproduced here, the format described above allows Haurin and Tolley to evaluate the distortions in the housing and public service sectors. Using simple single-equation OLS techniques, they obtained estimates for the income elasticity of demand for housing, public services and travel costs. These values are used to solve the mathematical model, and the following conclusions were reached:

(1) The distortion in the property tax creates a net loss to the rich in the city. Therefore, they have incentive to move to the suburbs.

(2) The distortion in property taxes also results in a dis-equilibrium in the central city housing market.

(3) The periphery of the urban area is extended excessively.

(4) This welfare loss can be reduced by the creation of a metropolitan government. In addition, if the central city is more industrialized than the suburbs, then the welfare loss will be further reduced.

These results are consistent with those obtained by Hamilton and Bradford and Kelejian.

The analysis of Haurin and Tolley contains many simplifying assumptions, such as the CBD, the use of a pure public good and the property tax as the sole source of revenue. It is apparent that the key to the model rests on the assumption that all upper class households should locate in the suburbs. In order to justify this, Haurin and Tolley specify a rent-bid function where the rich will live in the suburbs if:

$$\left[\frac{t_o}{Y_1^{\theta_1}} + t_Y\right] > \left[\frac{t_o}{Y_2^{\theta_1}} + t_Y\right]$$

where

t_0 = fixed transportation costs

t_Y = marginal time cost of travel (a constant)

Y_1 = the poor

Y_2 = the rich

θ_1 = income elasticity of demand for housing

Therefore, for $\theta_1 \geq 1$, the condition of complete segregation by income and jurisdiction will hold.

The assumption that t_Y is constant is not justified because it makes the rent-bid function linear with respect to transportation costs. Numerous studies such as Muth (RSA Papers, 1961) prove that the rent-bid curve is nonlinear with respect to transportation costs. This assumption is clearly erroneous, and it casts considerable doubts on the resultsof Haurin and Tolley. In Chapter 3 it will be shown that it is optimal for the rich to locate in the city under certain conditions. Although Haurin and Tolley's results are interesting, their model reinforces the restrictiveness of the conditions required for Tiebout efficiency.

2.2 Fiscal Analysis of Metropolitan Areas

2.21 Introduction

Coinciding with the post-war decentralization of urban areas, one of the most active areas of research in public finance has been the determinants of local government expenditures and revenues. The literature can be roughly classified into the following two categories. First, the bulk of the empirical research has sought to estimate the determinants of particular publicly provided urban services. Examples would include police and fire protection, sanitation and highways. The methodology employed in these studies was primarily single-equation multivariate

models, and per capita expenditures were used as the endogenous variable in most cases. Because of the rather simple econometric techniques employed, most of the debate has centered on the proper specification of these selected local services, using primarily cross-section data. Prominent studies in this area would include Brazer (1959), Woo Sik Kee (NTJ, 1965) and Hirsch (1973), though this list is practically limitless. In addition, there have been attempts to estimate aggregate expenditure functions within this single-equation framework. Illustrative of these efforts is Hansen (Restat, 1965).

The second major category of research is comprised of more complex simultaneous equation systems. For the most part these studies have attempted to estimate aggregate expenditure functions. For example, since measures of locally generated revenues are both determinants of expenditures as well as partially determined by the level of expenditures, a second equation for local revenues must be specified to eliminate this simultaneous equation bias. A model of this nature was developed by Henderson (Restat, 1968). Unfortunately, the addition of a local revenue equation is not sufficient by itself. The tremendous growth in non-local revenues from state and federal sources suggests the need of a third equation to complete the simultaneous system. Since non-local revenues are a component of local government expenditures, it is likely to be correlated with the error term in the expenditure equation. Therefore, non-local revenues should be treated endogenously if the estimated coefficients are to be unbiased and consistent. Horowitz (SEJ, 1968) has developed a model which incorporates this method.

A proper estimation procedure for local expenditures and revenues is crucial to this study. It is hypothesized that residential location decisions are influenced *ceteris paribus* by fiscal variations between central cities and their suburbs. Therefore, the fiscal variables must

be properly specified so that accurate estimates of these Tiebout forces can be obtained. An example where improper procedures were used was Oates' model. One should recall from the analysis in section 2.14 that Oates stressed that his results represented only an estimate of magnitude rather than a precise outcome. Through the use of a simultaneous equation approach, it is hoped that the results in this study will be somewhat more sharply defined.

The format of this section will be as follows. First, there will be some discussion of single equation methods of estimation. Although this study will be concerned with aggregate expenditures, many of the specification problems have been analyzed with respect to selected local functions. Second, the use of simultaneous equation systems will be discussed. The emphasis here will be on proper econometric techniques in a multi-equation system. Finally, potential econometric problems in this study will be addressed.

2.22 Single Equation Methods

Specific Functions

The analysis of single equation models for specific government functions will draw heavily from a study by Weicher (NTJ, 1970). Weicher states that previous studies of determinants of local government expenditures can be grouped into four categories:

1. the effects of political fragmentation in a metropolitan area.
2. the possibility of economies of scale in public goods provision.
3. the relationship between local expenditures and nonlocal revenue.
4. the effect of changes in fiscal capacity on local expenditures.

Weicher further points out that these categories are quite interrelated, and this is readily apparent particularly between the first and second topics as well as the third and fourth. Finally, Weicher suggests that

these studies are deficient in the sense that they do not consider what he terms "taste" and "service" conditions. The former refers to demographic and socioeconomic conditions, while the latter is viewed as those factors affecting input requirements. Weicher states that the inclusion of these variables into the equations for police and fire protection, sewers and sanitation and highways will provide insights into two major problems of cross-sectional single equation studies: multicollinearity and interstate differences in local responsibility.

Hirsch

Rather than discuss each of the studies cited by Weicher, a pioneering study by Hirsch (Restat, 1959) will be compared to a model specified by Weicher. The central focus of Hirsch's work was related to the first and second categories cited above. That is, Hirsch sought to determine whether or not scale economies exist in the provision of urban services. This factor has obvious implications for the optimal size of local governments in terms of pure efficiency considerations. For police protection Hirsch specified the following equation:

$$X_1 = \beta_0 + \beta_1 X_2 + \beta_2 X_2^{\,2} + \beta_3 X_3 + \ldots + \beta_{10} X_{10}$$

where

X_1 = per capita total costs of police protection

X_2 = nighttime population

X_3 = total miles of street

X_4 = nighttime population density per square mile

X_5 = percentage of nonwhite population

X_6 = percentage of nighttime population under 25 years of age

X_7 = combined receipts of wholesale, retail and service establishments

X_8 = number of wholesale, retail and service establishments

X_9 = index of scope and quality of police protection

X_{10} = average per capita assessed valuation of real property

With respect to Weicher's taxonomy, Hirsch's model does not include independent variables for the degree of political fragmentation or for nonlocal revenues. However, this is reasonable given that Hirsch was concerned with downtown areas, and that nonlocal revenues were not significant at that time.

Using ordinary least squares, Hirsch found that only X_5, X_6, X_9 and X_{10} were significant at the .05 level. Since the R^2 = .90, this suggests the presence of multicollinearity, and accordingly, the coefficients would have large standard errors and low T-statistics. Furthermore, X_7 and X_{10} not only impact on police costs, but they also reflect demand considerations in terms of ability to pay. Finally, Hirsch's scale proxies, X_2 and X_3, were not significant. Although this may be attributed to multicollinearity, Hirsch concludes that scale economies for police protection do not exist.

Weicher

Alternatively, Weicher's equation for police protection contained a total of twenty-one variables from a sample of 206 SMSA's and included proxies for each of the six categories. Of the twenty-one, twelve variables were significant at the .05 level, and they are arranged in their appropriate category below. The R^2 = .73 for the regression, which is somewhat lower than that for Hirsch. However, city population was not significant, and Weicher interprets this as support for the lack of economies of scale in the provision of police protection.

Table 2.1

Taste	Service	Fiscal Capacity
proportion of foreign stock	density	income
proportion of nonwhite	average size of manufacturing	unemployment
proportion of young persons		retail sales

Nonlocal Revenue	Political Fragmentation
per capita intergovernmental revenue	central city's share of SMSA manufacturing

Weicher's regression for police protection is illustrative of several points. First, he points out multicollinearity is an inherent problem with such models. However, Weicher defends himself in the following manner. He argues that the use of additional variables, which are not significant in the regression but correlated with other studies to become significant. This represents a rather curious method of econometric modeling. Furthermore, the presence of multicollinearity precludes any forthright examination of the magnitude of the estimated coefficients. Second, the excessive number of independent variables makes any interpretation of them exceedingly precarious. Therefore, in his extended efforts to expand the determinants of specific local expenditures to include taste and service conditions, Weicher has failed to respond to econometric difficulties which are prevalent in this area of research. Rather, he has reinforced them.

Hansen

Although models of aggregate expenditures within a single equation framework are relatively rare, one study will be analyzed in this section. Hansen attempts to specify equations for aggregate

expenditures, social services and the urban infrastructure. He designates these as overhead capital (OC), social overhead capital (SOC) and economic overhead capital (EOC) respectively. The criticisms which are cited below will be directed toward improper econometric techniques in this study. However, his theoretical contributions will receive only superficial treatment.

Hansen's division of public services is done in terms of the degree of horizontal and vertical integration. Services classified as SOC include education, fire and police protection, health and welfare and various amenities. Therefore, SOC can be viewed as having economies of scale which are exhausted at relatively low population levels. Alternatively, EOC is composed of such things as transportation systems and utilities. These services are primarily oriented to direct productive activity, and they are viewed as having relatively large economies of scale. The classification of SOC and EOC has been supported by Hirsch in the two studies cited previously.

A significant problem which is encountered by Hansen concerns his use of cross-section data. Since Hansen's endogenous expenditure variables include capital expenditures, one could argue that time-series data would be much more meaningful due to the lumpiness of public investment. Hansen tries to avoid this difficulty by utilizing the mean values of per capita capital outlays over a five year period as the endogenous variables. Although this certainly represents an improvement over one observation period, there is no _a priori_ justification for this particular time span, and it should be regarded as strictly arbitrary. One could expect substantial difficulties to arise with respect to older, declining urban areas compared to those which are relatively new and developing.

Hansen hypothesizes that SOC is determined by static variables such as absolute population and the density of industrial employment, whereas EOC is assumed to be sensitive to the growth rates of these variables. In other words, EOC is the result of population growth which exceeds the capacity of a service. The following regressions were estimated by ordinary least squares:

$$OC = 458 + 28.1(\Delta H/L) - 12.3A + 29.7(\Delta B/B) + 31.8C + 88.1(\Delta H/H) \qquad R^2 = .58$$

$$SOC = -196 + .08(P/L) + 22.7(\Delta H/L) + 28.0C + .58(I/P) \qquad R^2 = .569$$

$$EOC = 699 + 80.4(\Delta P/P) + 20.7(\Delta B/B) + 40.1(\Delta H/H) \qquad R^2 = .267$$

where OC, SOC and EOC = money outlays,

$\Delta H/L$ = change in housing density during the study period

A = percent of labor force in agriculture

$\Delta B/B$ = percentage change of built-up land

C = accessibility index

$\Delta H/H$ = percentage change in the number of houses

P/L = population density

I/P = industrial employment per 1000 population

$\Delta P/P$ = percentage change in population

The low coefficient of determination suggests that EOC is extremely sensitive to the lumpiness of capital outlays which was previously discussed. The argument can be made that EOC is particularly dependent on a minimum demand threshold. Therefore, heteroskedastic disturbances may be rather significant. However, Hansen does not appear to test for heteroskedasticity. In addition, multicollinearity is likely to be

present between the housing and population variables, but again, Hansen does not discuss this point.

This analysis suggests that capital expenditures should be deleted from cross-section studies. Furthermore, it also points out the need for a simultaneous equation approach to the problem. For example, EOC and OC are determined by rates of growth and development. However, one could argue that growth and development are determined by the capital infrastructure of an urban area, a process generally referred to as economies of agglomeration. Thus, it is apparent that Hansen's methodology has several weaknesses for the study of public expenditures.

2.23 Aggregate Expenditure Functions and Multiequation Models

Two models will be analyzed in this section. First, Henderson employed a two-equation model to explain local expenditures. The strengths and weaknesses of this model will be explored in depth, and it will be shown that it is inadequate because it treats nonlocal revenues as an exogenous variable. Second, Horowitz developed a generalized model for state and local government expenditures. In this model, nonlocal revenues are treated endogenously within a simultaneous equation framework, and the objections cited with respect to Henderson are met.

Henderson

Henderson utilizes a social welfare function as the theoretical foundation for the determinants of local government expenditures. Although the model which is developed is somewhat simplistic in terms of the specified predetermined variables, it contains both an expenditure and a tax equation. Therefore, by the use of two-stage least squares, Henderson is able to eliminate inconsistent and biased coefficients which would result from the correlation between the expenditure and tax

variables. It has been argued that expenditures and taxes represent a recursive rather than a simultaneous system (Vincent, 1971). Although it is possible that available revenues determine the level of expenditures in any one year, the relative elasticities of local expenditures to local revenues indicate that a simultaneous system is more appropriate.

Henderson's social welfare function, which he describes as a community's ordinal collective welfare, takes the form of:

$$(1) \quad W = (\alpha_0 + \alpha_1 Y + \alpha_2 R + \alpha_3 P) \ln G + X$$

where

Y = per capita income

R = per capita revenue from federal and state sources

P = population

X = per capita private expenditures

G = per capita government expenditures

The determinants of local revenues are specified as:

$$(2) \quad T = \beta(G - R)$$

Therefore, taxes are assumed to be a fixed proportion of the difference between per capita expenditures and per capita revenues from other sources ($0 < \beta < 1$). Thus, per capita local debt can be estimated as the residual: $D = G-T-R = (1-\beta)(G-R)$. If $\beta = 1$, then there is no public debt. By substituting the identity, $T = Y-X$ into (2), the community's budget constraint can be expressed as:

$$X + \beta G = Y + \beta R$$

Two assumptions are quite crucial at this point. First, although private savings does not enter into the model, the assumption that the savings rate does not vary across communities is a sufficient condition for

the identity, $T = Y-X$, to hold. Second, it is assumed that local representatives maximize G and X within the community.

The Lagrangian expression takes the form of:

$$(4) \quad L = (\alpha_0 + \alpha_1 Y + \alpha_2 R + \alpha_3 P) \ln G + X$$
$$- \lambda(X + \beta G - Y - \beta R).$$

Setting the partial derivatives equal to zero yields:

$$\partial L/\partial G = \frac{(\alpha_0 + \alpha_1 Y + \alpha_2 R + \alpha_3 P)}{G} - \lambda\beta = 0$$

$$\partial L/\partial X = 1 - \lambda = 0$$

$$\partial L/\partial \lambda = X + \beta G - Y - \beta R = 0,$$

and the first order conditions for maximization are:

$$(5) \quad G = \frac{\alpha_0}{\beta} \;\; \frac{\alpha_1}{\beta} Y + \frac{\alpha_2}{\beta} R + \frac{\alpha_3}{\beta} P$$

$$(6) \quad X = Y - \beta(G - R)$$

The Lagrangian multiplier is constrained to unity.

The equations in stochastic form are:

$$(7) \quad G_i = \frac{\alpha_0}{\beta} + \frac{\alpha_1}{\beta} Y_i + \frac{\alpha_2}{\beta} R_i + \frac{\alpha_3}{\beta} P_i + u_i$$

$$T_i = \beta(G_i - R_i) + V_i$$

Since Henderson views R as exogenous in the model, the expenditure equation is estimated with ordinary least squares. However, due to the inclusion of G in the tax equation, two-stage least squares must be used. Moreover, the intercept term in the tax equation is constrained to zero.

Henderson divides his cross-section sample into metropolitan and nonmetropolitan counties in order to gauge the impact of marginal changes

of the exogenous variables on local expenditures, private expenditures, local taxes and local debt. The strengths of his model are twofold. First, the use of two-stage least squares eliminates the probable simultaneous bias between the expenditure and tax variables. Second, his model contains a great deal of insight, particularly with respect to local debt.

However, there are three particular drawbacks. First, it can be argued that a social welfare function is an inappropriate tool of theoretical analysis. This is a point made by Arrow (1963) and Samuelson (QJE, 1956). Second, the coefficients of determination of Henderson's regressions were rather low, .65 and .55 for the expenditure equations and .39 and .38 for the tax equations. This may result from the aggregation of the demographic (population) and income variables. It would appear that the disaggregation of these explanatory variables would increase the explanatory power of the model.

The most important criticism, however, is the use of nonlocal revenues as an exogenous variable, and misspecification is suggested by the large coefficients for R. In addition, it seems more plausible, *a priori*, that R and G would be jointly determined by other exogenous variables. For example, counties with higher income are likely to be located in states with higher income. This would probably result in higher state tax collections, and thus, larger per capita R from state sources. From Henderson's results, the likelihood of misspecification can be amply supported, and this conclusion can be derived as follows. From equation (1)

$$dW/dY = \alpha_1 \ln G + \frac{Z}{G}\frac{dG}{dY} + \frac{dX}{dY}$$

$$dW/dR = \alpha_2 \ln G + \frac{Z}{G}\frac{dG}{dR} + \frac{dX}{dR} \quad \text{where}$$

$$Z = (\alpha_0 + \alpha_1 Y + \alpha_2 R + \alpha_3 P) \ .$$

From (5), it may be seen that $Z = G/B$. Therefore, $Z/G = 1/\beta$. From the total differentiation of (5) and (6), it is possible to determine dG/dY, dX/dY, dG/dR and dX/dR. Substituting the appropriate values in the above equations yields:

$$dW/dY = \alpha_1 \ln G + (1/\beta)^2\ \alpha_1 + (1-\alpha_1)$$

$$dW/dR = \alpha_2 \ln G + (1/\beta)^2\ \alpha_2 + (\beta-\alpha_2)$$

$dW/dY = 10.26$ metropolitan $\quad$ 1.42 nonmetropolitan

$dW/dR = 0.33$ metropolitan $\quad$ 6.28 nonmetropolitan

Therefore, $\dfrac{dW/dR}{dW/dY} = 7.4$ (metropolitan), 4.4 (nonmetropolitan)

This is a rather curious result, given that R is more likely to be constrained (i.e., categorical aid) relative to Y. With full fungability one would expect dW/dR to be equal to dW/dY. However, any restrictions placed on R would seem to indicate that dW/dR should be less than dW/dY. Thus, R should be viewed as endogenous within Henderson's model, and a third equation should be added with R as the dependent variable.

Horowitz

A much more satisfactory methodology was developed by Horowitz, who formulated a simultaneous equation system for the determinants of both state and local government expenditures. Therefore, it represents a more generalized model with the stated purpose of analyzing interstate differences in state and local per capita expenditures. Horowitz also specifies a model for the number of state and local governmental

employees per 10,000 population. However, this model will be ignored in the following discussion because the emphasis is on the determinants of expenditures only.

Although Horowitz developed a number of models for per capita expenditures, the one which yields the best results is specified as:

$$E = f(I,T,G,F_i), \quad i = 1,2$$

$$T = f(B,M)$$

$$G = f(I,M)$$

$$F_i = f(I, 1/P, E), \quad i = 1,2.$$

In reduced form the estimated expenditure equation is:

$$E = -540.12 + .14I + 2.27T + 624G + 1.01F_1 \qquad R^2 = .86$$

$$E = -549.43 + .14I + 2.36T + 600G + 1.26F_2 \qquad R^2 = .86$$

where

E = per capita expenditures

I = per capita income

T = Oppermann's measure of tax effort

G = distribution of income (Gini coefficient)

B = taxes paid per $1000 of personal income

M = manufacturing employees as a percent of total employees in the state

1/P = inverse of population

F_1 = per capita total revenue from the federal government

F_2 = per capita grants-in-aid

Two-stage least squares was utilized to estimate the expenditure equations, with the endogenous variables of each being replaced by their first-state estimates. One surprising result of the analysis is that all of the variables are significant at the .01 level with the

exception of G, the distribution of income. Horowitz justifies this phenomenon by stating that greater income inequality may result in a lesser demand for some goods and services, while being associated with a larger demand for others (poverty-related services). Thus, the conflicting effects would offset one another. One minor objection to this study is that the expenditure variable is per capita total expenditures. This implies that capital outlays are included, and the discontinuity of investment problem (similar to Hansen's difficulty) may bias the results. Second, the use of β as a determinant of tax effort may introduce a simultaneous equation bias.

The strength of this model refers to the treatment of federal grants, which is endogenous in the system. Horowitz points out that federal matching grants (e.g. highways) are a major component of state and local expenditures. This would also be true for such intergovernmental transfers as public welfare which do not require matching funds. Therefore, it would appear that federal grants and state and local revenues are mutually determined by other exogenous variables. Thus, Horowitz supports the conclusion reached in the criticism of Henderson's model. Within this framework both nonlocal and local sources of revenue and local expenditures are determined simultaneously, and the estimated coefficients of the reduced form expenditure equations are unbiased and consistent. This econometric procedure is clearly superior to those previously discussed.

2.24 Primary Conclusions

The purpose of this section has been to focus on the major empirical problems faced in the study of local government fiscal determinants. First, Weicher's study was illustrative of difficulties encountered with

the specification of local public expenditures and the interpretation of the independent variables. However, the introduction of taste and service conditions by Weicher would appear to be particularly relevant to the determinants of aggregate expenditures which will be focused upon in this study. On the other hand Weicher did little to rectify the problem of multicollinearity in such studies. In fact he appeared to defend improper econometric practices.

Second, it has been clearly demonstrated that a multi-equation system is required for the determinants of aggregate expenditures. This is due to the existence of a simultaneous bias between expenditures and revenue. Furthermore, revenues from local and nonlocal sources must be estimated separately. This results from the growing trend in intergovernmental revenues.

With respect to this study, a simultaneous equation system will be developed which corresponds to the needs previously discussed. However, problems may arise due to the use of cross-section data in this study. The previous analysis suggests that the discontinuity of public investment is incompatible with cross-section data. Therefore, capital outlays will be eliminated from the aggregate expenditure measure. The separate estimation of city and suburban expenditures and revenues is not expected to pose a serious difficulty.

CHAPTER 3

A THEORETICAL MODEL OF RESIDENTIAL LOCATION

3.1 Introduction

Prior studies on the determinants of residential location can be divided into two categories. First, some of the efforts have been directed to the impact of accessibility on location, with accessibility being defined in terms of the journey to work. Examples include Kain (RSA Papers, 1962), Muth (RSA Papers, 1961; 1969) and Fisher and Fisher (JRS, 1975). The second category has extended these accessibility models to include the effects of neighborhood quality on residential location, and they are represented by Harris et al. (Restat, 1968), Granfield (Applied Econ., 1974), Jackson (1975) and Stegman (JAIP, 1969). These studies will be briefly discussed in the following section.

In Chapter 2 it was seen that the Tiebout hypothesis has recently been converted into a theoretical and empirical framework for determining the impact of fiscal variations on residential location. Therefore, the purpose of this chapter is two-fold. First, a model will be developed which will demonstrate the impact of location on individual utility. It will therefore extend the theory of residential location by incorporating fiscal variables, which are assumed to be sensitive to spatial influences, into the models cited above. Second, this chapter will analyze the utility maximizing behavior of households. Different income groups will not respond to the same incentives in a spatial framework, and this is demonstrated by the existence of a rent-bid curve which portrays the economic rents that accrue to each location.

This traditionally takes the form of a negative exponential curve which peaks at the core of the city (the node) and falls to zero at the agricultural land on the periphery. The rent-bid curve represents an outcome of the competitive bidding for sites, and the effects of accessibility, neighborhood quality and fiscal variations can cause shifts, subnodes and discontinuities in the rent-bid curve. These effects will result from the impact of location on individual utility, and they will be explored in depth.

The following section will briefly discuss prior studies on residential location. Next, the individual utility function will be specified and analyzed. This function will incorporate the government sector into the traditional residential land use models, which are based primarily on accessibility. The last section will summarize the major findings from the theoretical model, and these conclusions will be related to the literature reviewed in Chapter 2.

One additional point should be made. The following model ignores the incentives which have brought about the decentralization of firms in metropolitan areas. Clearly, firms respond to similar forces as households: accessibility to markets and suppliers, and fiscal advantages. The decentralization of firms and households can be viewed as mutually supportive, and the rent-bid curve would be affected by the actions of both. However, the determinants of the location of firms will not be analyzed in this study.

3.2 Discussion of Previous Studies

Accessibility, an obvious determinant of residential location, can be defined in terms of the journey to work and the proximity to shopping and recreation facilities. This factor has received the most attention

in both theoretical and empirical research. Increasing accessibility has a positive effect on utility by reducing commuting costs, ceteris paribus, in the individual's budget constraint.

Early studies, such as those of Kain and Muth, viewed the journey to work as the most important determinant of location. However, these efforts made the restrictive assumption that employment was concentrated in a CBD. The rent-bid curve thus depended primarily on income and the substitution of commuting expenses for household expenditures.

More recent efforts have incorporated the decentralization of firms into the models. Goldberg (JRS, 1970) developed an analytic model to explain the intraurban location of manufacturing industries. His model verified a hypothesis stated by Vernon (1960), who argued that the location of manufacturing plants depends on the relative economies or diseconomies of central city location. Since larger firms are able to internalize many central city agglomeration economies, they are relatively footloose and are more likely to locate outside of the central city. Conversely, smaller firms are less able to internalize these external economies and tend to remain in the central city. However, this model was not empirically tested.

Alternatively, Fisher and Fisher employed econometric techniques to analyze the decentralization of both firms and households. Using a simultaneous equation approach, they found that employment and residential location are jointly determined. This reinforces the view that the decentralization of firms and households are mutually supportive, and it breaks away from the restrictiveness of a model which is based on a CBD.

One of the basic assumptions of the accessibility models is that the urban area is located on a homogeneous plain. However, this is

clearly not the case, and amenities can be expected to vary widely from one location to another. This will, in turn, affect the utility derived from a specified location.

Harris et al. point out that if amenities were completely divisible and could be produced at constant costs, then households would choose location on the basis of commuting costs alone. Accordingly, the price of amenities would be independent of location. It is unlikely, however, that the condition of constant costs exists. For example, unique features may endow locations with characteristics that cannot be easily reproduced. In their empirical analysis, amenities are found to be a major component of land value. Furthermore, the income elasticity of demand was in the range which indicates that amenities are superior goods.

Granfield developed a three equation recursive model of residential location. First, a budget for housing services is established. Second, the housing budget as well as amenities and accessibility are used to determine location in terms of distance from the CBD. Finally, the budget and distance from the CBD determine housing type. His results suggest that neighborhood quality rather than accessibility is the dominant determinant of location.

Jackson (1975) extends the spatial theory of consumer behavior developed by Muth (1969) to include neighborhood characteristics such as pollution, racial composition and income status. Using the concept of housing services, Jackson specifies a household production function in which housing services are a function of land, structure and neighborhood attributes. Jackson goes on to construct hedonic price indices for housing services at different locations in a metropolitan area (Milwaukee), which are based in part on neighborhood characteristics.

Stegman employs survey methods, and his conclusions are in contrast with those of Kain and Muth. First, his survey suggests that urban services and activities are no more accessible to inner city residents than to suburban residents. This results from both decentralization and the construction of expressways, which effectively reduce transportation costs. Second, suburban families are very concerned with neighborhood quality. Therefore, he concludes that the tradeoff between accessibility and neighborhood quality may not be valid. Suburban households are able to have both according to Stegman's survey.

An obvious extension to the models discussed here is the inclusion of a fiscal sector. Just as accessibility and neighborhood quality will vary with location, fiscal advantages will vary by jurisdiction. Individual utility based on these characteristics will be developed in the following section.

One major drawback to the comparative static analysis is that housing is viewed in terms of a flow of services in one time period, and housing as an investment good is ignored. For example, the argument can be made that a home represents the primary asset of many households. The household can be viewed as a firm which attempts to maximize its net value over time, such as in Jorgenson's model (AER, 1963). Accordingly, the household's future expectations with respect to location will be an important determinant in terms of the city-suburb location decision. If uncertainty is introduced, a risk-averse household may be biased toward the selection of the relatively homogeneous jurisdiction. Thus, a "switching model" between alternative locations would be appropriate with time-series data. A limited dependent variable of a similar nature was developed by Trost (1977), who analyzed the rent-ownership decisions of households. Such a model would be effective

for estimating intertemporal location decisions. However, this issue is beyond the scope of this study.

3.3 Individual Utility and Residential Location

3.31 A Scenario

The purpose of the forthcoming model is to examine why people reside in certain locations. Before proceeding with the mathematical model, a graphic representation can clarify the analysis. First, assume the simplest case where there is no government, all economic activity is located at the core and housing and neighborhood quality are homogeneous. Furthermore, assume that there are only two income groups. From Figure 1, it can be seen that the upper income group (Y_1) will occupy the most accessible locations, and the lower income group (Y_2) will reside only from a to b. Figure 1 is consistent with the model developed by Muth.

Next, assume that office buildings and a shopping center are located in the hinterland. This represents the decentralization of retail firms and employment. As can be seen in Figure 2, the rent-bid curves are no longer continuously declining from the core, and a subnode is established at N. Retaining the previous assumptions, Y_1 will reside from the core to a and from b to c. Accordingly, Y_2 would locate from a to b and from c to d.

Finally, assume that two governments are instituted with a political boundary at J. From Figure 3, two results predominate. First, the rent-bid curves exhibit a discontinuity at J. Second, the Y_1 income group is primarily concentrated in the suburbs. This implies that Y_1 receives a fiscal advantage from locating beyond J. The central question is: what caused the fiscal advantage?

DIAGRAM 1

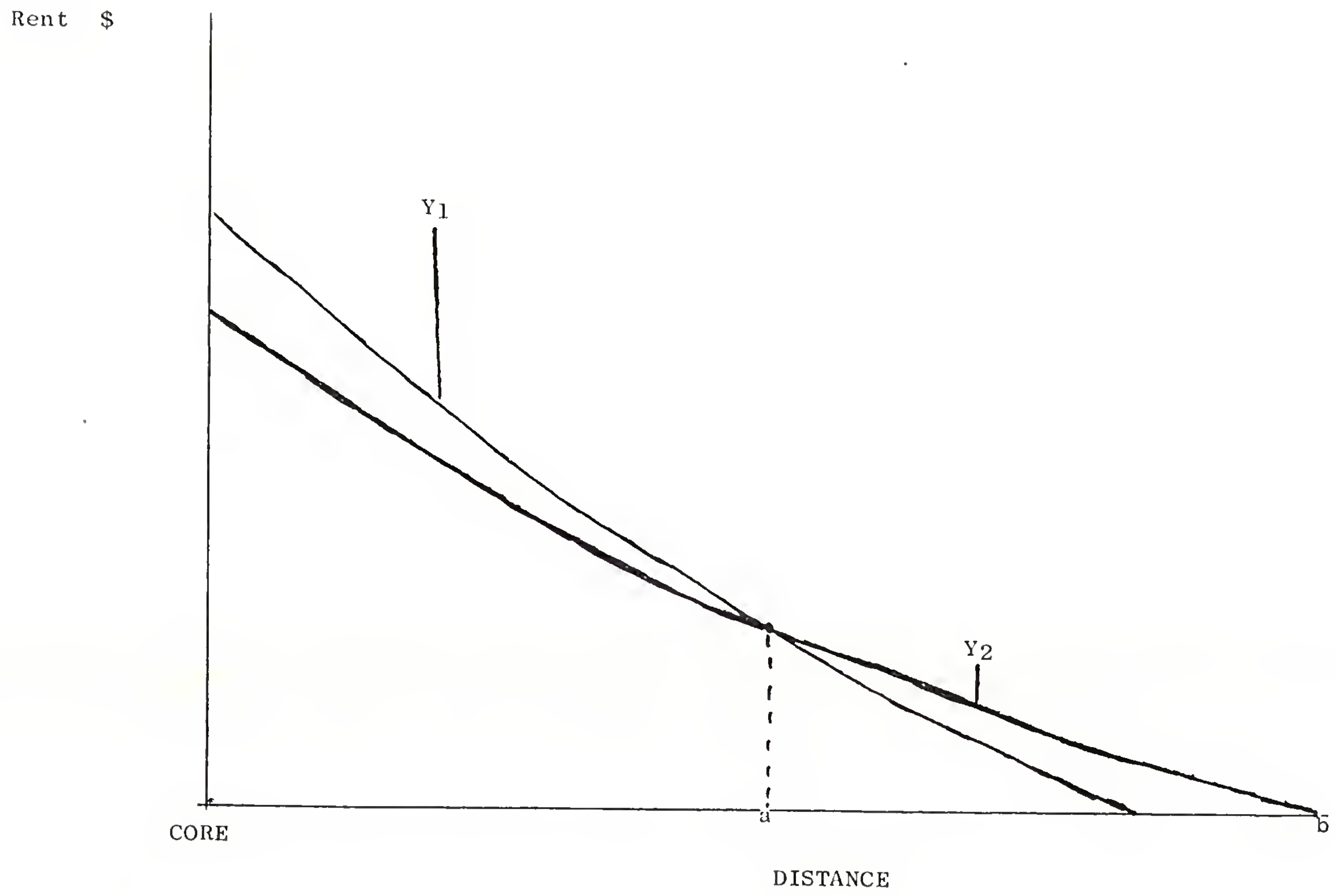


DIAGRAM 2

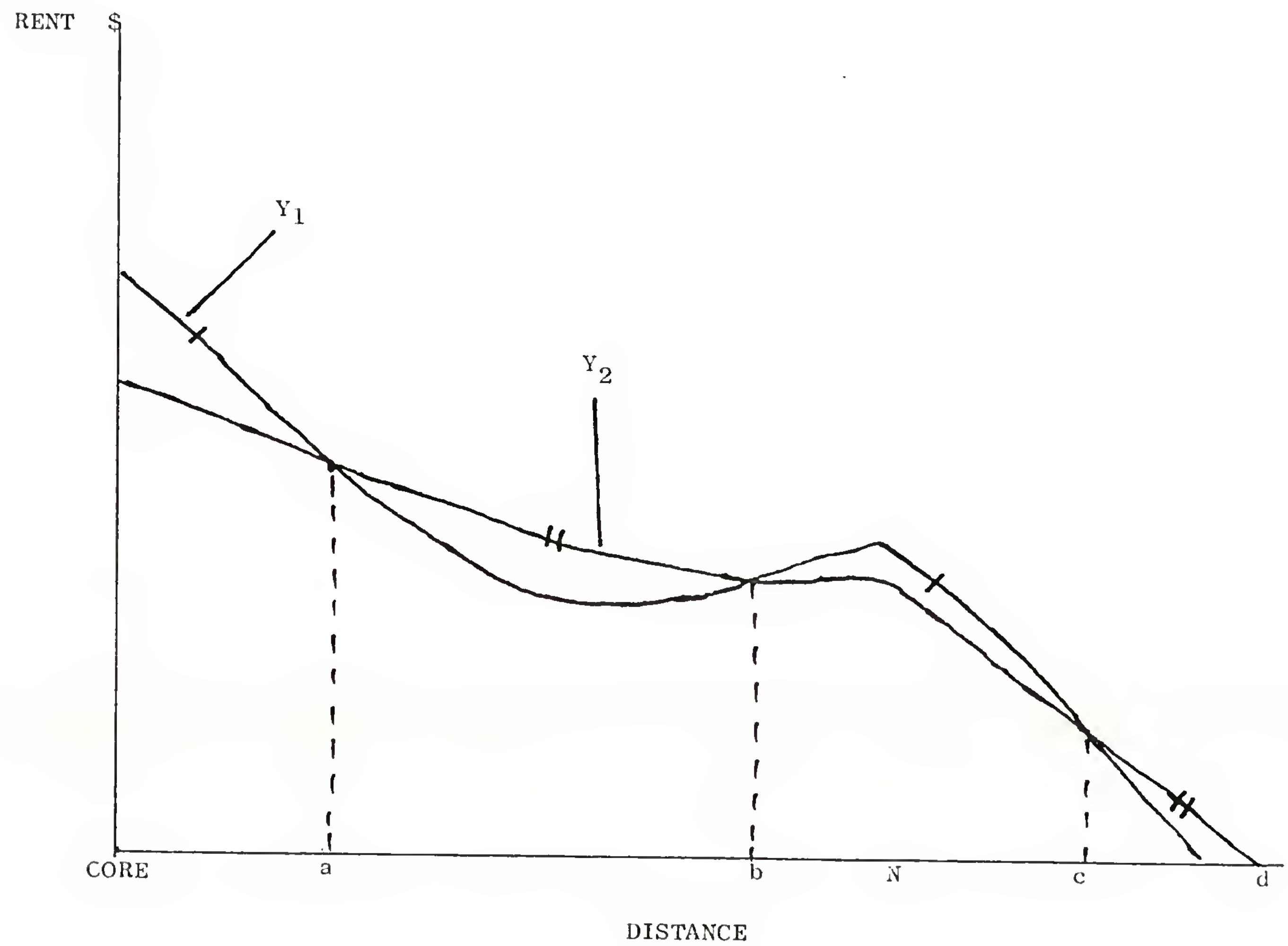
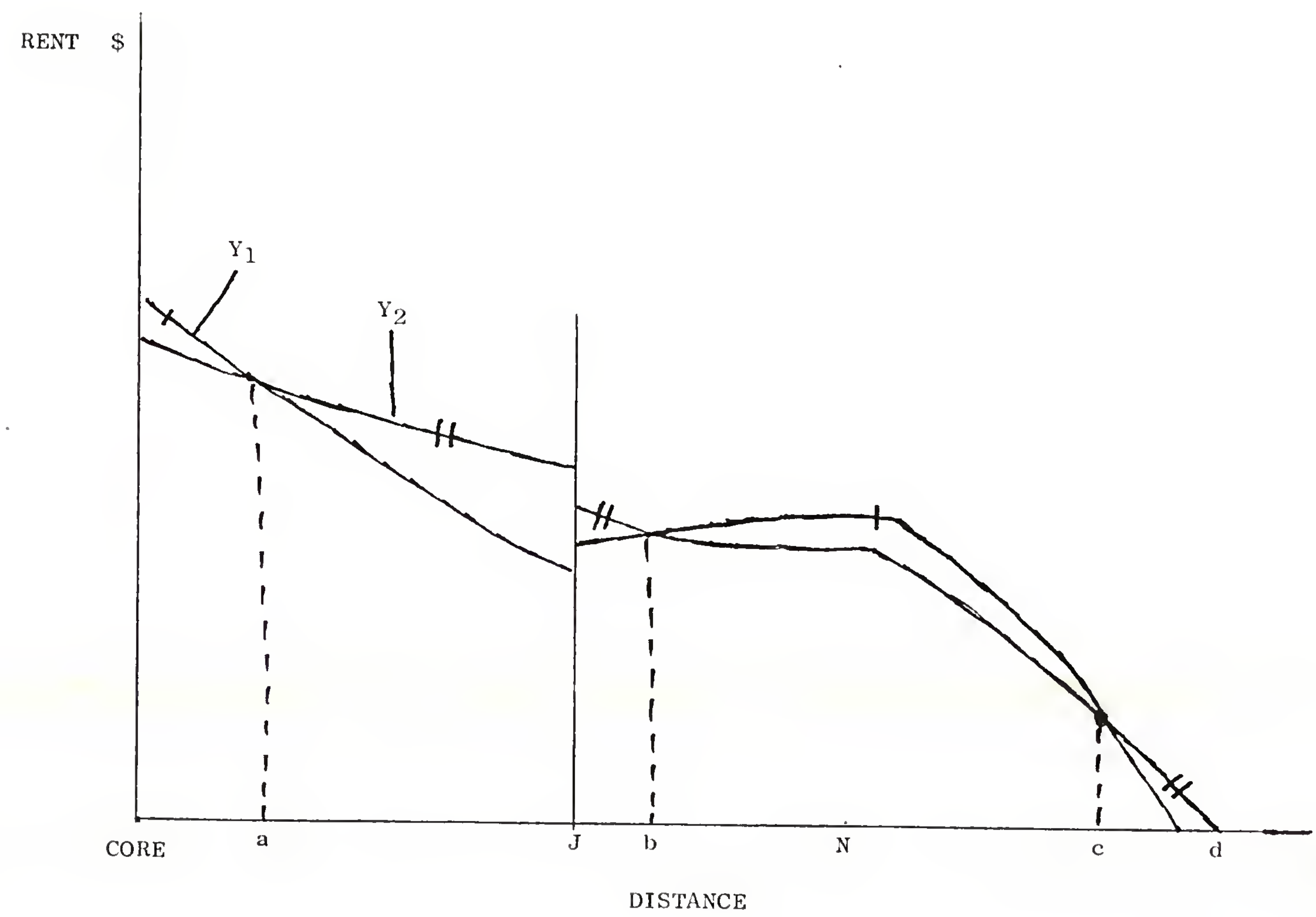


DIAGRAM 3



The initial stimulus to upper income suburban flight may result from two conditions:

(1) Public services are normal goods.

(2) The rich are myopic.

Since the rich (Y_1) were originally located in the central cities as in Figure 1, the level of public services would be relatively high in this jurisdiction, particularly with respect to social services, since the poor are relatively small in number. The rich falsely assumed that the number of poor would not increase. However, the inmigration of the poor from the south to the central cities altered this situation. The poor moved into the central city where inexpensive housing and unskilled jobs were available, and it became advantageous for the rich to move out. The burden on the rich was continually increasing in the city, and a cumulative flight phenomenon was established. Improved transportation modes, federal housing policies which encourage suburbs and preferences to locate with one's "class" only reinforced this trend. Therefore, the rent-bid curve for Y_1 in the city would be declining over time, whereas it would be increasing in the suburbs. The reverse would be true for the poor (Y_2). Although the scenario is rather simplistic, it does offer some insight into how a residential distribution such as Figure 3 could result.

It is apparent that the term "location must comprise several meanings in the following utility function. With respect to accessibility, it implies distance. However, neighborhood quality attaches neighborhood amenities to specific locations. Finally, the concept of fiscal variations implies that location can be defined as a specific jurisdiction.

It is important to recognize, however, that the discussion deals with the "voting with one's feet" in the tradition of the Tiebout model. One should recall that this model does not specify how budgets and the mix of taxes and expenditures are established in the first place. It seems to assume that budgets do not change, and that voter-consumers will vote primarily through the mechanism of mobility. In the real world it is clear that voter preferences for fiscal considerations can be reflected at the polls and by other means.

Clearly, a complex model should consider both types of voter-consumer response, and it should include an explicity consideration of the relative costs of responding to each. Voting with feet involves moving costs, and voting at the ballot entails transactions costs and costs associated with group dynamics. The utility function developed below will concentrate on the migration aspect of voter-consumer behavior. It is assumed that this mechanism is the most efficient response for household to make, particularly for the middle class. However, this restriction does not appear to be unreasonable in view of the focus on this study.

Individual utility with respect to residential location will be defined in terms of housing services a composite of private goods and public goods. The concept of public goods used in this section does not refer to Samuelson's definition of public goods; rather, it encompasses those goods and services that are provided by local governments.

Utility in this model will be subject to both a time and an income constraint. Nelson (Urban Studies), 1973) suggests that residential location can be explained, ceteris paribus, by examining the land rent differences which will produce consumer indifference among locations with different accessibilities. Traditional analyses assume that rent differentials essentially compensate for transportation costs at varoius locations in the urban area. Nelson points our several difficulties with this method. First, accessibility is usually defined with respect to one central location, normally the CBD. Second, the number of trips to the CBD is assumed to be perfectly inelastic in terms of costs per trip. Third, time costs as a component of travel costs are ignored.

The latter criticism is an adaptation of a model developed by Becker (Ec. Journal, 1965). With the addition of an effective time constraint, the price of any good has two components: a money price and a time price. Thus, the total price is equal to the money price plus an opportunity cost which is equal to the loss of income from not working while consuming the good. Although Johnson (WEH, 1966) has argued that the time price should be evaluated at less than the individual's wage rate, wage rates will be used in this model.

3.32 The Utility Function

For static analysis with certainty, a utility function of this specification would appear as:

$$(1) \quad U_i = U_i(X,\ H,\ G(k))$$

subject to:

$$w\ell = P_X X + P_H\left(k,\ \frac{G(k)}{P_G(k,H,w\ell)}\right.\ H + P_G(k,H,w\ell)\ G(k)$$

and

$$T = \ell + t_R(k) + t_X X + t_H H + t_G G$$

where

U_i = utility of the individual in the i^{th} income group

H = housing services

G = public goods

X = composite private good (including leisure)

ℓ = labor

k = location

w = wage rate

P_H = price of housing services

P_X = private good numeraire

P_G = local tax price of public goods

t_R = transportation time

T = total time allocation (24 hours)

t_G = time cost of public goods

t_X = time cost of private goods

t_H = time cost of housing services

It should be noted that housing services refer to land, structure and neighborhood attributes. To aid in the mathematical analysis, $\underline{H}$ does not vary with $\underline{k}$. It is assumed that housing services are reproducible for an appropriate P_H, which does vary with $\underline{k}$. This assumption requires that "natural" amenities are ubiquitous, which is in contrast to the model of Buchanan and Goetz. However, it does not detract from the goal of analyzing the impact of fiscal variations on residential location. The ratio of government services to their tax price is the measure of fiscal variation, and from this point on, it will be referred to as FV. Finally, the tax price of public services

will vary by location, housing services (property tax) and income.

Substituting the second constraint into the first, and setting up the Lagrangian expression yields:

$$(2)\quad L = U_i[X,H,G(k)] - \lambda\{(P_X + t_X w)X + [P_H(k,FV) + t_H w] H + [P_G(k,H,w\ell) + t_G w]G(k) + wt_R(k) - wT\} = 0.$$

Differentiating with respect to X, H, k and λ gives the first order conditions:

$$(3)\quad \frac{\partial L}{\partial X} = U_X - \lambda(P_X + t_X w) = 0$$

$$(4)\quad \frac{\partial L}{\partial H} = U_H - \lambda[(P_H + t_H w) + H\frac{\partial P_H}{\partial FV} FV'(H) + P_G'(H)G(k)] = 0$$

$$(5)\quad \frac{\partial L}{\partial k} = U_G G'(k) - \lambda[(P_H'(k) + \frac{\partial P_H}{\partial FV} FV'(k)) + P_G'(k)G(k) + G'(k)(P_G(k) + t_G w) + t_R'(k)w] = 0$$

$$(6)\quad \frac{\partial L}{\partial \lambda} = \{(P_X + t_X w)X + [P_H(k,FV) + t_H w]H + [P_G(k,H,w\ell) + t_G w]G(k) + wt_R(k) - wT\} = 0$$

Taking the total derivative of the first order conditions yields:

$$(7)\quad U_{XX}dX + U_{XH}dH + U_{Xk}dk - d\lambda(P_X^*) = \lambda d(P_X^*)$$

$$(8)\quad U_{HX}dX + U_{HH}dH + U_{Hk}dk - d\lambda(a) = \lambda d(a)$$

$$(9)\quad U_{GX}G'(k)dX + U_{GH}G'(k)\ dH + U_{GG}G'(k)\ dk$$

$$+ U_G G''(k)\ dk - d\lambda(b) = \lambda d(b)$$

$$(10)\quad -P_X^*dX - [c]dH - [e]dk = - d(wT) + Xd(P_X^*)$$

$$+ H\ d[c] + k\ d[e]$$

where:

$$P_X^* = P_X + t_X w$$

$$a = [(P_H + t_H w) + H \frac{\partial P_H}{\partial FV} FV'(H) + P_G'(H)G(k)]$$

$$b = [H(P_H'(k) + \frac{\partial P_H}{\partial FV}\ FV'(k)) + P_G'(k)G(k)$$

$$+ (P_G(k) + t_G w)\ G'(k) + t_R'(k)w]$$

$$c = [P_H(k,FV) + t_H w]$$

$$e = \{[P_G(k,H,w\ell) + t_G w]\ G(k) + t_R(k)w\}\ .$$

The second order conditions for utility maximization require that the bordered Hessian be negative definite. Therefore, for the bordered Hessian determinant, $\bar{H}$ =

$$\begin{vmatrix} U_{XX} & U_{XH} & U_{Xk} & -P_X^* \\ U_{HX} & U_{HH} & U_{Hk} & -[a] \\ U_{GX}G'(k) & U_{GH}G'(k) & U_{GG}G'(k)+ U_G G''(k) & -[b] \\ -P_X^* & -[c] & -[e] & 0 \end{vmatrix}$$

$\bar{H}_2 > 0$, and $\bar{H}_3 < 0$. Assuming that the marginal and cross-partial arguments are positive, and that the second derivatives are negative, then these conditions are met unambiguously.

3.33 Comparative Static Analysis

The purpose of this analysis is to determine why different income groups may reside in different locations (as in Figure 3). The most appropriate framework under conditions of certainty is to utilize comparative static analysis. This method allows for an examination of the income effects on housing services and location by income group.

Equations (7), (8), (9) and (10) in matrix form would appear as:

$$\begin{bmatrix} U_{XX} & U_{XH} & U_{Xk} & -P_X^* \\ U_{HX} & U_{HH} & U_{Hk} & -[a] \\ U_{GX}G'(k) & U_{GH}G'(k) & U_{GG}G'(k) + U_G G''(k) & -[b] \\ -P_X^* & -[c] & -[e] & 0 \end{bmatrix} \begin{bmatrix} dX \\ dH \\ dk \\ d\lambda \end{bmatrix} = \begin{bmatrix} \lambda d(P_X^*) \\ \lambda d[a] \\ \lambda d[b] \\ Z \end{bmatrix}$$

where

$$Z = -d(wT) + Xd(P_X^*) + Hd[c] + kd[e] \ .$$

Using Cramer's Rule, it becomes possible to solve for dH and dK:

$$dH = \frac{\begin{vmatrix} U_{XX} & \lambda d(P_X^*) & U_{Xk} & -P_X^* \\ U_{HX} & \lambda d[a] & U_{Hk} & -[a] \\ U_{GX}G'(k) & \lambda d[b] & U_{GG}G'(k)+U_GG''(k) & -[b] \\ -P_X^* & Z & -[e] & 0 \end{vmatrix}}{D}$$

$$dk = \frac{\begin{vmatrix} U_{XX} & U_{XH} & \lambda d(P_X^*) & -P_X^* \\ U_{HX} & U_{HH} & \lambda d[a] & -[a] \\ U_{GX}G'(k) & U_{GH}G'(k) & \lambda d[b] & -[b] \\ -P_X^* & -[c] & Z & 0 \end{vmatrix}}{D}$$

where D is the determinant of the coefficient matrix. Solving the numerator by expanding cofactors, simplifying and differentiating by wT yields the income effects (assuming that all prices are constant) for housing services and location. These are given below:

$$(11) \quad \frac{\partial H}{\partial (wT)} = \frac{-\{(-a)[U_{GX}G'(k)U_{Xk}-U_{XX}(U_{GG}G'(k)+U_GG''(k))]+(-b)(U_{XX}U_{Hk}-U_{Xk}U_{HX})+(-P_X^*)[U_{HX}(U_{GG}G'(k)+U_GG''(k))-U_{Hk}U_{GX}G'(k)]\}}{D}$$

$$(12) \quad \frac{\partial k}{\partial (wT)} = \frac{\{[(-aG'(k))(U_{GX}U_{XH}-U_{XX}U_{GH})]+[(-b)(U_{XX}U_{HH}-U_{XH}U_{HX})]+[(-P_X^*G'(k))(U_{HX}U_{GH}-U_{HH}U_{GX})]\}}{D}$$

Before analyzing the income effect, it is necessary to examine the components of [a] and [b]. From the preceding discussion, it can be seen that land rents at any one location are determined by accessibility, neighborhood quality and now, fiscal variations. Each of these factors will be capitalized. With respect to [a], the land rents will include

the term, $H \frac{\partial P_H}{\partial FV} FV'(H)$, which shows the effect of neighborhood quality on the fiscal variation that impacts on the price of housing services. For example, if a low-income housing project was located in an upper class neighborhood which had a fiscal advantage, then land rents in that area may be lowered ($FV'(H) < 0$, $\frac{\partial P_H}{\partial FV} > 0$). This assumes that some of the poverty-related services would be borne locally.

However, [b] has a substantially larger impact on land rents, and this is represented by $H(P_H'(k) + \frac{\partial P_H}{\partial FV} FV'(k)) + t_R'(k)w$. This term includes the capitalized value of location, fiscal advantages and accessibility. Accordingly, k assumes three dimensions in this context:

(1) Neighborhood attributes

(2) A political jurisdiction

(3) Distance

If upper income groups are assumed to gain a fiscal advantage in the suburbs, and housing services and location are normal goods, then it is likely this income group will reside in the suburbs as in Figure 3. However, if housing services and location are inferior goods ($\frac{\partial H}{\partial (wT)} < 0$, $\frac{\partial k}{\partial (wT)} < 0$), this result is not clear-cut. The effects of transportation costs to the central city may outweigh other factors.

The argument can be made that after some threshold is reached, the marginal utility of public services will fall to zero for the rich. For example, children are sent to private rather than public schools, private alarm systems are installed as a substitute for police protection, and poverty services do not provide any direct benefits. Therefore, with respect to $\frac{\partial H}{\partial (wT)}$, U_G, U_{GG}, $G'(k)$, $G''(k)$ and [a] are likely to be quite small. Although the first bracket is indeterminate in sign in (11), the last two brackets are definitely positive. Since the numerator is multiplied by a negative one, and D is negative, housing services must

be considered as normal good.

This is not necessarily true for the sign of $\frac{\partial k}{\partial(wT)}$. Assuming that the poor are concentrated in the central city, it is likely that $G'(k)$ can be zero or even negative. Alternatively, $t_R'(k)w$ is likely to be quite larger because of $\underline{\underline{w}}$, and the numerator is positive ($U_{XX}U_{Hk} < 0$, $U_{Xk}U_{HX} > 0$). Thus, the conditions for $\frac{\partial k}{\partial\ (wT)} < 0$ can be met. If under certain circumstances location becomes an inferior good (which in the "weak" case only require that $\frac{\partial k}{\partial(wT)}$ be negative), the location of residences will vary for members of the same income group.

The implications of this model are far-reaching. The next section will summarize the conclusions which can be drawn from the model and will relate them to the rent-bid curves in Section 3.3. In addition, they will be incorporated into the literature reviewed in Chapter 2.

3.4 Implications of the Model

A Consideration of Locational Attributes

A major conclusion derived from the mathematical model was that location can become very complex under certain conditons, particularly for high income groups. This implies that if income increases, less "location" is demanded. Since location takes on several meanings in this model, the first requirement is to determine exactly what is meant by location.

Location in this model was defined in terms of neighborhood attributes, accessibility and government jurisdictions. With respect to neighborhood and government, the implications are rather straightforward. Demanding less of these goods as income increases suggests that an individual will sacrifice some neighborhood amenities and fiscal advantages in the choice of residential location. Assume that the suburbs are characterized by less crime and pollution and that upper

income households can derive a fiscal advantage by locating there. If some aspects of location are inferior goods, however, then the upper income household will demand fewer neighborhood amenities, and the fiscal advantage will not be appropriate. Accordingly, all other goods must be superior in the aggregate. Since the introduction of the government sector restricts residential choice to a city of suburban jurisdiction, this analysis suggest that the upper income household will reside in the central city.

Examining location in terms of accessibility presents more of a problem. In other words, what is the economic interpretation of "less" accessibility? It was stated previously that accessibility was properly defined in terms of the journey to work, shopping and recreation. If one makes the assumption of a CBD, where all economic activity occurs, then accessibility will decline with distance from the CBD. However, the advent of surburban shopping centers, industrial parks and office buildings invalidates this assumption. According to Stegman, suburban residents have better access to central city facilities than city residents. It is likely that improve transportation facilities (highways) and the increasing decentralization of firms have further increased accessibility in the suburbs. Therefore the argument can be made that residential location in the central city will result in "less" accessibility, using the broad definition of accessibility given above.

This conclusion appears to contradict the traditional residential land use models discussed previously. One should recall, however, that these models viewed accessibility in terms of the journey to work, which represents a limited definition of accessibility. The fact that land rents are higher in the central city, as depicted in rent-bid curves, is not inconsistent with the broad definition used in the model in 3.3. This is because households must compete with business for

sites in the central city to a greater degree than in the suburbs. Land rents will accordingly decline from the central city.

The Rent-Bid Curves

The rent-bid curves depicted in Figures 1-3 will clarify this analysis. Figure 1 is representative of land rents in a mononuclear city, where employment and shopping are concentrated in the central city. The rich would occupy the most accessible sites.

Figure 2 represents the decentralization of firms and households. The slope of the rent-bid curve is reduced, and a secondary peak is established. From the model in 3.3, this results from two effects: $P_H'(k)$ and $T_R'(k)$. The former depends on suburban neighborhood amenities (and is assumed positive), and the latter refers to increased accessibility that is determined by suburban development. Decentralization implies that density in the suburbs has increased, and Figure 2 is the result.

When a government sector is introduced, the rent-bid functions will not be continuous if there is fiscal variation between the city and the suburbs. The discontinuity would be produced by the effects of $G'(k)$, $P_G'(k)$, $\partial P_H/\partial FV$ and $FV'(k)$, and it is depicted in Figure 3. It should be noted that the impact of government also produces a change in the slope of the rent-bid function in this example. However, the shift and/or slope change depends on which income group derives a fiscal advantage in each jurisdiction.

The rent-bid curves in Figures 1-3 are used to illustrate the effects of location on utility. It has been argued that the government sector is an important determinant of residential location, and this has been demonstrated in both the graphical and mathematical analyses. The next step is to relate this model to the literature on the Tiebout hypothesis.

The Relation to the Tiebout Literature

The theoretical literature analyzed in Chapter 2 was primarily concerned with the efficiency aspect of the Tiebout hypothesis. Buchanan and Goetz point out that efficiency in the public sector is limited in two respects. First, resources in the private sector are not ubiquitous, and the population distribution between jurisdictions that is optimal in the private sector may produce a nonoptimal solution in the public sector. Second, an inmigrant into a community can impose congestion costs which are greater than the increased cost-sharing of the tax burden.

Hamilton argued that zoning, defined as a minimum expenditure for housing, could produce efficiency in the public sector. In this example, the property tax becomes an efficient pricing mechanism that does not carry an excess burden. Hirsch and Margolis develop a model which disputes the conclusions derived by Hamilton. They argue that the property tax is not an efficient pricing mechanism for public goods. This results in a distortion in the housing market, whereby a nonoptimal substitution occurs between the location of single and multifamily housing.

The primary conclusion drawn from these models is that a movement toward Tiebout equilibrium would require residential segregation by income. Zoning ordinances would be required to maintain this equilibrium. The model developed in section 3.3 clearly demonstrates the restrictiveness of the Tiebout model, which requires that $\partial P_H/\partial FV$, $P_G'(k)$ and $FV'(k)$ must equal zero. Furthermore, the analysis of Buchanan and Goetz demonstrates that $P_H'(k)$ must also equal zero. In other words, Tiebout efficiency can exist only when location is not capitalized in the price

of housing or in the price for public goods. The conclusions drawn from the model in 3.3 and Figures 1-3 suggest that Tiebout efficiency is not likely to be realized.

The empirical models discussed in Chapter 2 are primarily concerned with the issue of Tiebout-induced mobility. The models of Aronson and Schwartz and Bradford and Kelejian demonstrate that fiscal variations are a determinant of residential location. This implies that the parameters cited above are not equal to zero.

Haurin and Tolley develop a model which calculates the welfare losses that result from inefficiency in the central city public sector. These welfare losses are derived from distortions in the housing and public goods markets. The assumption that upper income groups should reside in the suburbs is crucial to their analysis. However, the model in section 3.3 demonstrated that under certain conditions, it is optimal for an upper income household to locate in the central city. Location, as defined in 3.3, becomes an inferior good under these circumstances.

Primary Conclusions

The purpose of this chapter has been to extend the basic results obtained from traditional residential land-use models and the Tiebout literature. By dropping some of the restrictive assumptions of such models, more realistic concepts of housing services and accessibility can be formulated, and testable hypotheses can be developed.

Of more critical importance is the introduction of the government sector into a model of residential location. Two major conclusions can be deduced from the model. First, Tiebout efficiency is extremely unlikely in the context of a metropolitan area. This point has been

developed in prior studies. Second, residential segration is <u>not</u> optimal under certain conditions. The concept of location as an inferior good is a sufficient condition for this result, and it has not be consider in the literature. Again, it should be recognized that the theoretical model in this chapter explicitly assumes that the residential response to fiscal variations across jurisdictions is achieved primarily by a change in locational choice, rather than by the formation of coalitions or clubs to achieve budgetary responses in existing locations.

The model in the following chapter will empirically test the hypothesis that residential location can be explained by accessibility, neighborhood quality and fiscal advantages. The model will estimate the determinants of location for three income groups, and the sample will be divided into growing and declining central cities. The theoretical model has developed utility functions for individual households. It will be assumed that the actions of income groups represent an aggregate response. Therefore, instead of looking at individual households, the dependent variable will relate the relative concentration of various income classes to the locational attributes developed in this chapter. The sensitivity of location to fiscal variations will be determined by simulating the effects of the institution of a consolidated government. It is assumed that consolidation will eliminate the sources of fiscal variation within a metropolitan area. Therefore, spatial quality differentials with respect to public services will be ignored. In terms of the model in 3.3, $\underline{\underline{k}}$ will drop out of the equations for public services (G) and the tax price (P_G), and the price for housing services (P_H) will no longer

be influenced by FV. Thus the sensitivity of residential location to fiscal variations can be ascertained.

The utility function demonstrates that households will respond to disequilibrium conditions. Attempts to neasure this response will cross-section data may not be fruitful. It should be noted that the empirical tests of the Tiebout hypothesis and of other residential location models typically have been done with cross-section data. The theoretical model in this chapter, therefore, raises serious questions about the received body of empirical tests on the residential location response to disequilibrium conditions.

CHAPTER 4

THE EMPIRICAL MODEL AND RESULTS

4.1 The Data

4.11 The Sample

The sample in this study consists of 50 metropolitan areas, all of which had central city populations in excess of 100,000 persons in the 1960 census. In the sample, 24 central cities had populations which increased between 1960-1970, and 26 central cities suffered population declines. Excluded from the sample were those SMSA's in which the primary city was located in more than one county. This was necessary because the simulation assumes consolidation will occur between a central city and a surrounding county. An example of this exclusion rule would be Atlanta, Georgia.

Table 4.1 gives the population of the central cities, the suburbs and the 1960-1970 percentage change in population in the central city. The suburban population is defined to be the county population minus the central city population. This definition is deficient for two reasons. First, some large counties may include rural areas which are not true "suburbs." Second, the surrounding county in heavily urbanized areas may not comprise some areas which are suburbs. However, since the model in this study assumes consolidation will occur between a central city and a surrounding county, this derivation of the respective central city - suburban populations will be utilized.

One can see from Table 4.1 that most of the central cities with growing populations were located in the south and west. Some exceptions

to this trend include two rapidly growing university communities (Lansing, Michigan and Madison, Wisconsin) and four central cities which had positive population growth due to annexation (Peoria, Illinois; Tulsa, Oklahoma; Columbus, Georgia; and Corpus Christi, Texas). Conversely, most of the central cities in the sample with declining populations are located in the north and east. Therefore, this sample is consistent with recognized demographic trends of the 1960's.

The sample provides many contrasts. First, the central city populations range from Chicago, Illinois (3.4 million) to Duluth, Minnesota (100,600). Second, the suburbs range in population from 2.1 million in Chicago to 13,300 in Columbus, Georgia. Finally, the percentage of central city population to the total county population varies from a low of 19% (Hartford, Connecticut) to 92% (Columbus, Georgia). Therefore, the sample is characterized by regional diversity and substantial differentials with respect to population.

Significant differences can also be noted with respect to the population characteristics of the central cities. Seven central cities in the north and east had population densities of over 9000 persons per square mile. Alternatively, fourteen central cities in the sample had population densities of less than 3000 persons per square mile, eleven of which were located in the south and west. In addition, blacks comprised less than 10% of the total population in nineteen central cities in the sample. Eight of these cities are located in the southwest and west. This figure is somewhat misleading, though, since most of these cities have substantial concentrations of Mexican-Americans which represent the "minorities" in these areas.

Finally, twenty-three central cities had declining civilian employment between 1960-1970. As expected, these cities correspond

exactly to those which had a net decrease in population during this period. The erosion of the tax base in these cities comes from two sources: the movement of residents (predominantly middle and upper income) from the core city to the suburbs and the decentralization of firms. However, many households and firms left the northeast entirely and relocated in the sunbelt states. It is worthy to note that all of the suburban areas in the sample had net increases in civilian employment. The only exceptions to this trend were those areas which had annexations.

4.12 The Calculation of the Income Class

The empirical model in this study estimates a location equation for three income groups, designated as lower, middle and upper income classes. Since this classification is used to develop the endogenous variables of the regression equations, an acceptable method for determining the respective income groupings is extremely important. Bradford and Kelejian (see 2.1) developed a rather sophisticated income distribution series in which the income groupings were designated on a percentile basis for their cross-section analysis. The strength of this Lorenz curve procedure is obvious. By altering the percentiles of the various income groups, tests of robustness are possible. However, they define the poor in terms of a single definition of the poverty level ($3800 in 1960) that ignores regional differences in the distribution of income. One would expect that a poverty level in Mississippi would be substantially less than in New York, for example. Bradford and Kelejian do not disclose the source of their data, and it is not possible to determine how their income series were generated.

Census data, which is utilized in the following model, measures the distribution of income on a discrete rather than a continuous basis.

Table 4.1

City (County)	1970 Central City Population (in thousands)	Central City Population 1960-1970 % Change	1970 Suburban Population (in thousands)
Birmingham, Al. (Jefferson)	300.7	-11.7	344.3
Mobile, Al. (Mobile)	190.0	-2.5	127.3
Phoenix, Az. (Maricopa)	581.6	32.4	385.9
Tucson, Az. (Pima)	262.9	23.5	88.8
Little Rock, Ark. (Pulaski)	132.5	22.9	154.7
Fresno, Cal. (Fresno)	166.0	23.9	247.0
Sacramento, Cal. (Sacramento)	254.4	34.1	377.1
San Diego, Cal. (San Diego)	696.6	21.6	661.2
San Jose, Cal. (Santa Clara)	446.5	118.7	618.2
Hartford, Conn. (Hartford)	158.7	-2.6	658.0
St. Petersburg, Fl. (Pinellas)	216.1	19.2	306.2
Savannah, Ga. (Chatham)	118.3	-20.7	69.5
Columbus, Ga. (Muscogee)	154.1	32.8	13.3
Chicago, Ill. (Cook)	3362.8	-5.1	2125.5
Peoria, Ill. (Peoria)	127.0	23.1	68.3
Evansville, Ind. (Vanderburgh)	138.7	-2.0	30.1
Des Moines, Iowa (Polk)	200.8	-3.6	85.3
Wichita, Kan. (Sedgwick)	276.7	8.6	74.0
Topeka, Kan. (Shawnee)	124.9	4.6	30.4
Louisville, Ky. (Jefferson)	361.5	-7.4	333.6
Flint, Mich. (Genesee)	193.4	-1.8	251.0
Lansing, Mich. (Ingham)	131.6	21.9	129.4
Grand Rapids, Mich. (Kent)	197.5	11.5	213.5
Minneapolis, Minn. (Hennepin)	434.4	-10.0	525.7
Duluth, Minn. (St. Louis)	100.6	-5.9	120.1
Jackson, Miss. (Hinds)	154.0	6.6	61.0
Omaha, Neb. (Douglas)	347.4	15.0	42.1
Newark, N.J. (Essex)	382.4	-5.7	547.6
Jersey City, N.J. (Hudson)	260.5	-5.7	348.8
Albuquerque, N.M. (Bernalillo)	243.8	21.2	72.0
Buffalo, N.Y. (Erie)	462.8	-13.1	650.7
Rochester, N.Y. (Monroe)	296.2	-7.0	415.5
Syracuse, N.Y. (Onandango)	197.3	-8.7	275.4
Greensboro, N.C. (Guilford)	144.2	20.5	144.4
Charlotte, N.C. (Mecklenburg)	241.2	19.7	113.5
Cleveland, Ohio (Cuyahoga)	751.0	-14.3	970.3
Cincinnati, Ohio (Hamilton)	452.6	-10.2	471.5
Dayton, Ohio (Montgomery)	243.5	-7.4	362.6
Tulsa, Ok. (Tulsa)	331.8	26.2	69.9
Pittsburgh, Pa. (Allegheny)	520.2	-13.9	1084.8
Erie, Pa. (Erie)	129.2	-6.7	134.5
Providence, R.I. (Providence)	179.2	-13.7	401.1
Houston, Tex. (Harris)	1232.4	31.4	509.5

Table 4.1 (continued)

City (County)	1970 Central City Population (in thousands)	Central City Population 1960-1970 % Change	1970 Suburban Population (in thousands)
Beaumont, Tex. (Jefferson)	116.0	-1.4	128.8
Corpus Christi, Tex. (Nueces)	204.6	22.0	32.9
Salt Lake City, Utah (Salt Lake)	175.8	-7.2	282.8
Seattle, Wash. (Pierce)	154.6	4.3	256.4
Madison, Wisc. (Dane)	173.2	35.6	117.1
Milwaukee, Wisc. (Milwaukee)	717.1	-3.2	337.0

Source: County and City Databook 1972, U.S. Dept. of Commerce, Bureau of the Census.

Families are allocated to one of the following income levels: less than \$3000, \$3000-\$5000, \$5000-\$7000, \$7000-\$10,000, \$10,000-\$15,000, \$15,000-\$25,000 and more than \$25,000. The percentage of families in each category is given in the census data. Since the empirical model which is analyzed in 4.2 tests the sensitivity of residential location within a metropolitan area, the endogenous variables must have two characteristics. First, it should be sensitive to regional variations in income. Second, the measure must show the relative density of the income classes in the central city vis-a-vis the suburbs. The second requirement was ignored by Bradford and Kelejian, whose endogenous variables was simply the percentage of middle class families who reside in the central city.

The endogenous variables in this study are calculated as an index. For example, the index for the middle class is defined as: $MS/FS \div MC/FC$, where MS and MC are the number of middle class families in the suburbs and central city respectively, and FS and FC refer to the total number of families in each area. Alternatively, Bradford and Kelejian's method is simply: $MC/(MC+MS)$. An index with a value greater than unity thus implies that that particular income group is relatively more concentrated in the suburbs.

The use of an index is required by the data, but it also provides greater insight into an urban area. For example, assume that sixty percent of the middle class families in a metropolitan area resides in the central city. This is the measure used by Bradford and Kelejian, and it would appear that the middle class is concentrated in the central city. If there are twice as many families living in the central city than in the suburbs, then on a relative density basis, the middle class will be more concentrated in the suburbs. Therefore, the index more accurately depicts the relative location of income groups in a metropolitan

area.

Given the lumpiness of the census data on income distribution, a rule must be established that will determine the income classes. It was decided that the middle class was the key, as the upper and lower income groups could be calculated as residuals once the middle class is established. The rule for the middle class is as follows. First, the census data provided a measure for white median family income. The income category that this level fell into was used as the base. Next, the middle class was defined to be the percentage of families in the base category plus the percentage of families in the next highest income group. For example, it the white median family income in an area is $9,000, then the middle class would be defined to be the number of families in the $7,000-$10,000 group plus the $10,000-$15,000 group. This procedure is done for both the central city and the suburbs, and it becomes possible to calculate the percentage of middle class families in each area. It can be noted that this data precludes the use of the endogenous variable employed by Bradford and Kelejian.

Once the middle class is determined, it is relatively simple to calculate the upper and lower income index. The upper class is taken as the residual percentage of families in the income levels above the middle class, while the lower class is derived as the percentage of familes in the categories below the middle class.

The percentages of each income group and the respective indices are listed for each metropolitan area in Table 4.2. The procedure that has been described takes into consideration differences in regional income. For example, the base level in the wealthier regions is in the $10,000-$15,000 category, whereas the poorer areas are in the $7,000-$10,000 level.

represents an obvious drawback of this procedure. A method such as the one Bradford and Kelejian utilized is extremely costly, but the use of indexation mitigates this problem somewhat. Since the same income categories are used for both the central cities and the suburbs, the indices do reflect the relative concentrations of each income group. By utilizing white median family income as a benchmark, it appears that the designation of the income groups is reasonably accurate. From Table 4.2, it can be seen that the middle class is primarily concentrated in the suburbs, that the lower class is essentially in the central city and that the upper class also tends to concentrate in the suburbs. This is consistent with accepted locational patterns.

4.13 The Calculation of the Fiscal Variables

The most important variable in the empirical model is the measure of fiscal variation. This variable is clearly crucial to the testing of the Tiebout hypothesis. Since the measurement of quality differentials with respect to local public goods is in its infancy, fiscal variations can be most accurately measured in terms of expenditures for public goods and services and the tax price for them between the central city and the suburbs.

A crucial simplifying assumption utilized in this study is that suburbs are assumed to be homogeneous with respect to local government expenditures and revenues. This assumption is clearly unrealistic for some metropolitan areas such as Pittsburgh and Cleveland, which have several municipalities in the suburbs that do not provide homogeneous public goods and services. However, the homogeneity assumption is required for two reasons. First, this study tests the sensitivity between the central city and its suburbs which are cotermunous within a county boundary.

Table 4.2

	% Middle Class		Index Sub/	% Upper Class		Index Sub/	% Lower Class		Index Sub/
	CC	Sub	CC	CC	Sub	CC	CC	Sub	CC
Birmingham, Al.	45.1	48.3	1.07	11.0	18.8	1.71	43.9	32.9	.75
Mobile, Al.	42.4	41.4	.98	15.4	7.9	.51	42.2	50.7	1.20
Phoenix, Az.	45.1	43.1	.96	4.6	4.8	1.04	50.3	52.1	1.04
Tucson, Az.	47.8	43.5	.91	16.1	24.2	1.50	36.1	32.3	.89
Little Rock, Ark.	37.8	33.3	.88	5.0	1.7	.34	57.2	65.0	1.14
Fresno, Cal.	46.8	42.3	.90	16.8	17.6	1.05	36.4	40.1	1.10
Sacramento, Cal.	43.7	52.6	1.20	4.4	4.7	1.07	51.9	42.7	.82
San Diego, Cal.	45.4	46.4	1.02	5.6	4.2	.75	49.0	49.4	1.01
San Jose, Cal.	59.4	58.0	.98	4.5	9.1	2.02	36.1	32.9	.91
Hartford, Conn.	41.0	62.3	1.52	2.6	7.6	2.92	56.4	30.1	.53
St. Petersburg, Fl.	38.6	41.3	1.07	13.9	14.7	1.06	47.5	44.0	.93
Savannah, Ga.	39.0	53.9	1.38	13.2	16.3	1.23	47.8	29.8	.62
Columbus, Ga.	43.6	51.5	1.18	13.0	9.0	.69	43.4	39.5	.91
Chicago, Ill.	47.1	64.7	1.37	4.4	10.7	2.43	48.5	24.6	.51
Peoria, Ill.	48.3	51.7	1.07	6.3	3.3	.52	45.4	45.0	.99
Evansville, Ind.	51.0	55.1	1.08	15.1	23.6	1.56	33.9	21.3	.63
Des Moines, Iowa	47.4	56.6	1.19	4.3	6.3	1.47	48.3	37.1	.77
Wichita, Kan.	51.2	57.0	1.11	18.6	18.1	.92	30.2	24.9	.82
Topeka, Kan.	51.6	56.8	1.10	18.1	16.5	.91	30.3	26.7	.88
Louisville, Ky.	36.4	52.6	1.45	3.3	5.4	1.64	60.3	42.0	.70
Flint, Mich.	47.6	60.5	1.27	3.5	4.7	1.34	48.9	34.8	.71
Lansing, Mich.	52.6	52.6	1.00	3.6	8.2	2.28	43.8	39.2	.89
Grand Rapids, Mich.	45.5	54.7	1.20	4.6	5.2	1.13	49.9	40.1	.80
Minneapolis, Minn.	45.6	64.1	1.41	4.1	9.7	2.37	50.3	26.2	.52
Duluth, Minn.	52.5	59.2	1.13	16.8	9.8	.58	30.7	31.0	1.01
Jackson, Miss.	35.4	37.9	1.07	4.7	2.5	.53	59.9	59.6	.99
Omaha, Neb.	46.4	56.7	1.22	5.0	7.7	1.54	48.6	35.6	.73
Newark, N.J.	33.0	53.4	1.62	1.7	12.8	7.53	65.3	33.8	.52
Jersey City, N.J.	49.1	51.7	1.05	18.3	20.2	1.10	32.6	28.1	.86
Albuquerque, N.M.	44.6	42.2	.95	22.5	10.3	.46	32.9	47.5	1.44
Buffalo, N.Y.	38.5	56.6	1.47	2.4	5.3	2.21	59.1	38.1	.64
Rochester, N.Y.	46.9	68.1	1.45	3.1	9.5	3.06	50.0	22.4	.45
Syracuse, N.Y.	40.1	58.0	1.45	4.4	5.8	1.32	55.5	36.2	.65
Greensboro, N.C.	44.5	40.5	.91	6.6	3.7	.56	48.9	55.8	1.14
Charlotte, N.C.	41.8	53.6	1.28	5.3	5.6	1.06	52.9	40.8	.77
Cleveland, Ohio	41.2	61.0	1.48	1.9	9.8	5.16	56.9	29.2	.51
Cincinnati, Ohio	37.3	56.7	1.52	4.4	7.3	1.66	58.3	36.0	.62
Dayton, Ohio	44.4	61.0	1.37	2.6	7.1	2.73	53.0	31.9	.60
Tulsa, Ok.	43.9	37.5	.85	5.1	1.6	.31	51.0	60.9	1.19
Pittsburgh, Pa.	36.8	49.4	1.34	4.0	5.4	1.35	59.2	45.2	.76
Erie, Pa.	54.8	56.8	1.04	13.3	17.8	1.34	31.9	25.4	.80
Providence, R.I.	45.8	55.0	1.20	15.1	18.1	1.20	39.1	26.9	.69
Houston, Tex.	43.4	54.8	1.26	5.8	4.8	.83	50.8	40.4	.80

Table 4.2 (continued)

	% Middle Class		Index Sub/	% Upper Class		Index Sub/	% Lower Class		Index Sub/
	CC	Sub	CC	CC	Sub	CC	CC	Sub	CC
Beaumont, Tex.	39.1	39.6	1.01	4.5	2.1	.47	56.4	58.3	1.03
Corpus Christi, Tex.	44.2	35.6	.81	16.2	9.2	.57	39.6	55.2	1.39
Salt Lake City, Utah	45.5	58.2	1.28	18.2	19.7	1.08	36.3	22.1	.61
Seattle, Wash.	50.9	61.6	1.21	6.3	7.2	1.14	42.8	31.2	.73
Tacoma, Wash.	51.1	50.7	.99	17.8	21.4	1.20	31.2	27.9	.89
Madison, Wisc.	53.5	51.9	.97	6.4	6.2	.97	40.1	41.9	1.04
Milwaukee, Wisc.	49.6	60.4	1.22	2.4	9.1	3.79	48.0	30.5	.64

Source: County and City Databook 1972, U.S. Dept. of Commerce, Bureau of the Census.

Second, the data on local government expenditures and revenues is given in terms of cities and counties. There is no specific data on the suburbs, and the assumption of homogeneous suburbs is required under these circumstances.

Little attempt has been made to determine the breakdown of expenditures and revenues between central cities and their suburbs. The most extensive study for a single area was done by Green et al. (1974) in the Washington, D.C. metropolitan area. This was basically the same procedure that Neenan developed in Detroit (NTJ, 1970). However, this process is impossible to duplicate for a sample of fifty metropolitan areas because of cost and data requirements. Callahan and Sacks (1973) provide a reasonable methodology. They provide estimates of per capita expenditures, local revenues and nonlocal revenues for the 72 largest SMSAs in 1970. Since their study utilizes the SMSA as the unit of reference, it differs from this study, which uses a specific county. However, their method of allocating expenditures and revenues between the central city and suburbs was essentially followed in this study, and the procedures are fully described below. The estimates obtained by Callahan and Sacks cannot be directly compared with the results derived in this study. Their data represents revenues and expenditures for SMSAs in 1970. In addition, they exclude charges and miscellaneous from the revenue estimates. Finally, their sample differs substantially. It should be noted that Bradford and Kelejian also used the allocation technique of Callahan and Sacks to derive their measure of fiscal variation (MFISC).

The procedure for allocating expenditures and revenues can be described in the following manner. First, data on expenditures by type is given for both the central city and the county. When the city is subtracted from the county levels, a residual is obtained. If this

Table 4.3
Allocation of Expenditures and Nonlocal Revenues

	Expenditures					
	Education		Welfare		Nonlocal Revenues	
	Area Specific	Proportion of School Children (Residual)	Area Specific	Proportion of Poor Families (Residual)	Area Specific	Per Capita (Residual)
Birmingham, Al.		*		*		*
Mobile, Al.		*		*		*
Phoenix, Az.		*		*		*
Tucson, Az.		*		*		*
Little Rock, Ark.		*		*		*
Fresno, Cal.		*		*		*
Sacramento, Cal.		*		*		*
San Diego, Cal.		*		*		*
San Jose, Cal.		*		*		*
Hartford, Conn.	*		*		*	
St. Petersburg, Fl.		*		*		*
Savannah, Ga.		*		*		*
Columbus, Ga.		*		*		*
Chicago, Ill.		*		*		*
Peoria, Ill.		*		*		*
Evansville, Ind.		*		*		*
Des Moines, Iowa		*		*		*
Wichita, Kan.		*		*		*
Topeka, Kan.		*		*		*
Louisville, Ky.	*			*	*	
Flint, Mich.		*		*		*
Lansing, Mich.		*		*		*
Grand Rapids, Mich.		*		*		*
Minneapolis, Minn.		*		*		*
Duluth, Minn.		*		*		*
Jackson, Miss.		*		*		*
Omaha, Neb.		*		*		*
Newark, N.J.	*			*	*	

Table 4.3 (continued)
Allocation of Expenditures and Nonlocal Revenues

	Expenditures: Education		Expenditures: Welfare		Nonlocal Revenues	
	Area Specific	Proportion of School Children (Residual)	Area Specific	Proportion of Poor Families (Residual)	Area Specific	Per Capita (Residual)
Jersey City, N.J.	*			*	*	
Albuquerque, N.M.		*		*		*
Buffalo, N.Y.	*			*	*	
Rochester, N.Y.	*			*	*	
Syracuse, N.Y.	*			*	*	
Greensboro, N.C.		*		*		*
Charlotte, N.C.		*		*		*
Cleveland, Ohio		*		*		*
Cincinnati, Ohio	*			*	*	
Dayton, Ohio		*		*		*
Tulsa, Ok.		*		*		*
Pittsburgh, Pa.		*		*		*
Erie, Pa.		*		*		*
Providence, R.I.	*		*		*	
Houston, Tex.		*		*		*
Beaumont, Tex.		*		*		*
Corpus Christi, Tex.		*	*			*
Salt Lake City, Utah		*		*		*
Seattle, Wash.		*		*		*
Tacoma, Wash.		*		*		*
Madison, Wisc.	*			*		*
Milwaukee, Wisc.		*		*		*

Table 4.4

	Per Capita Expenditures		Per Capita Local Revenues		Per Capita Nonlocal Revenues	
	CC	Sub	CC	Sub	CC	Sub
Birmingham, Al.	175	140	161	114	78	63
Mobile, Al.	185	147	153	126	79	72
Phoenix, Az.	232	212	175	171	107	80
Tucson, Az.	232	217	168	188	96	73
Little Rock, Ak.	153	133	126	129	69	53
Fresno, Cal.	423	404	246	280	225	194
Sacramento, Cal.	426	301	340	216	184	166
San Diego, Cal.	288	271	206	206	145	129
San Jose, Cal.	351	330	271	239	160	141
Hartford, Conn.	297	211	295	202	72	55
St. Petersburg, Fl.	230	157	229	153	49	47
Savannah, Ga.	225	181	188	116	96	89
Columbus, Ga.	209	227	105	101	157	131
Chicago, Ill.	247	244	237	180	87	60
Peoria, Ill.	192	183	228	179	52	38
Evansville, Ind.	212	233	157	118	100	70
Des Moines, Iowa	244	214	239	202	58	35
Wichita, Kan.	237	265	210	197	105	85
Topeka, Kan.	230	216	231	200	87	67
Louisville, Ky.	159	216	191	182	49	77
Flint, Mich.	340	225	313	168	132	98
Lansing, Mich.	325	212	277	151	133	94
Grand Rapids, Mich.	224	196	183	141	120	90
Minneapolis, Minn.	301	238	300	171	116	78
Duluth, Minn.	325	346	274	203	182	127
Jackson, Miss.	202	157	200	146	61	51
Omaha, Neb.	217	205	234	196	46	36
Newark, N.J.	473	308	362	218	92	106
Jersey City, N.J.	302	265	304	202	58	75
Albuquerque, N.M.	212	167	135	118	118	111
Buffalo, N.Y.	359	290	288	169	122	162
Rochester, N.Y.	388	293	303	178	151	150
Syracuse, N.Y.	317	312	274	149	100	217
Greensboro, N.C.	216	177	175	121	122	94
Charlotte, N.C.	227	161	163	96	100	79
Cleveland, Ohio	293	213	284	192	80	48
Cincinnati, Ohio	260	287	260	253	71	99
Dayton, Ohio	250	185	280	144	84	56
Tulsa, Ok.	181	182	165	201	53	42
Pittsburgh, Pa.	255	199	264	172	96	60
Erie, Pa.	191	165	167	130	69	55
Providence, R.I.	224	167	214	140	73	54
Houston, Tex.	176	156	177	123	51	46
Beaumont, Tex.	225	215	227	218	58	56

Table 4.4 (continued)

	Per Capita Expenditures		Per Capita Local Revenues		Per Capita Nonlocal Revenues	
	CC	Sub	CC	Sub	CC	Sub
Corpus Christi, Tex.	233	249	180	274	89	83
Salt Lake City, Utah	192	206	188	157	85	80
Seattle, Wash.	242	234	211	178	122	92
Tacoma, Wash.	258	188	170	118	136	107
Madison, Wisc.	251	240	184	160	151	83
Milwaukee, Wisc.	311	301	272	215	171	100

The data is derived from the 1967 Census of Governments Vol. 4, No. 4, "Finances of Municipalities and Township Governments," and No. 5, "Compendium of Government Finances," U.S. Department of Commerce, Bureau of the Census.

residual is quite large, the service is considered to be county-supplied, and the residual is allocated between the city and suburbs. The same allocation holds if the service is city-supplied (i.e. the residual is quite small). If the central city provides the service for itself, then the residual expenditures described above are allocated to the suburbs. This is referred to as an area-specific allocation. When a specific expenditure is not area-specific, the residual is allocated in the following manner:

(1) education - relative number of school-age children

(2) welfare - relative number of poor families

(3) all other expenditures - per capita basis

Estimates of the per capita expenditures for the central cities and suburbs in the sample are given in Table 4.4. Capital outlays are not included in the expenditures. The allocation procedure for education and welfare in each area is given in Table 4.3.

Second, revenues are also given for the central city and the county. However, an appropriate method for allocating the residual is far more difficult than for expenditures, and adjustments must be judiciously applied. Local revenues are divided into three categories: (1) property taxes, (2) all other taxes and (3) charges and miscellaneous. Property tax revenues are allocated on the basis of area-specific, net valuation of assessed property (residual) and per capita residual. Other taxes and charges and miscellaneous are similarly distributed on an area-specific, per capita residual or per capita total basis. Callahan and Sacks ignore charges and miscellaneous in their study, and that omission appears to be a serious flaw since many central cities gain a significant proportion of their revenues from this source. Per capita local revenues are also given in Table 4.4, and the allocation

procedure for each area is depicted in Table 4.5.

Third, nonlocal revenues are distributed as either area-specific or per capital residual. Estimated per capita nonlocal revenues are listed in Table 4.4, and the allocation for each area is given in Table 4.3.

The allocation procedures for each metropolitan area for expenditures and revenues are described in Tables 4.3 and 4.5, respectively. The expenditures involved a much simpler process since the data generally showed whether specific services were provided on a county or county and city basis. For example, most of the areas under study had consolidated school districts, and total education expenditures were allocated by the relative proportion of school children (K-12) residing in the central city and the suburbs. If education was an area-specific function, this implied that the central city had an independent school district.

Revenues were must less clear-cut. Application of a common allocation method for all metropolitan areas was first attempted, and the basic rules involved were:

(1) an area-specific allocation for the property tax in areas of independent school districts; otherwise, the residual was allocated on the basis of the relative net assessed valuation of property between the central city and the suburbs.

(2) an area-specific basis for other taxes and charges and miscellaneous.

However, this base-line method provided unreasonable results in most instances. For example, revenue estimates were clearly out of line with expenditures by as much as 100%. Therefore, it became necessary to adjust the allocation of charges and miscellaneous and sales taxes on other than an area-specific basis. Since the former was more significant for a larger number of central cities, it was relied upon

Allocation of Local Revenues

	Property Tax: Area Specific	Property Tax: Net Value (Residual)	Property Tax: Per Capita (Residual)	Other Tax: Area Specific	Other Tax: Per Capita Total	Charges and Misc.: Area Specific	Charges and Misc.: Per Capita (Residual)	Charges and Misc.: (Total)
Birmingham, Al.		*		*			*	
Mobile, Al.		*		*				*
Phoenix, Az.		*		*		*		
Tucson, Az.			*		*	*		
Little Rock, Ark.			*	*		*		
Fresno, Cal.		*		*				*
Sacramento, Cal.		*		*			*	
San Diego, Cal.		*		*		*		
San Jose, Cal.			*	*				*
Hartford, Conn.	8			8			8	
St. Petersburg, Fl.			*	*		*		
Savannah, Ga.		*		*			*	
Columbus, Ga.			*	*				*
Chicago, Ill.		*			*			*
Peoria, Ill.		*			*			*
Evansville, Ind.		*		*				*
Des Moines, Iowa		*		*		*		
Wichita, Kan.		*		*				*
Topeka, Kan.		*		*				*
Louisville, Ky.	*			*			*	
Flint, Mich.			*	*		*		
Lansing, Mich.		*		*		*		
Grand Rapids, Mich.			*	*		*		
Minneapolis, Minn.		*		*				*
Duluth, Minn.		*		*		*		
Jackson, Miss.		*		*		*		
Omaha, Neb.			*	*			*	
Newark, N.J.		*		*			*	
Jersey City, N.J.		*		*		*		

Allocation of Local Revenues

	Property Tax			Other Tax		Charges and Misc.		
	Area Specific	Net Value (Residual)	Per Capita (Residual)	Area Specific	Per Capita Total	Area Specific	Per Capita (Residual)	Per Capita (Total)
Albuquerque, N.M.		*		*		*		
Buffalo, N.Y.			*		*	*		
Rochester, N.Y.			*		*	*		
Syracuse, N.Y.			*		*	*		
Greensboro, N.C.		*		*		*		
Charlotte, N.C.		*		*				*
Cleveland, Ohio		*		*			*	
Cincinnati, Ohio	*			*		*		
Dayton, Ohio		*		*			*	
Tulsa, Ok.			*	*		*		
Pittsburgh, Pa.		*		*			*	
Erie, Pa.		*		*			*	
Providence, R.I.	*			*			*	
Houston, Tex.		*		*			*	
Beaumont, Tex.			*	*		*		
Corpus Christi, Tex.		*		*			*	
Salt Lake City, Utah			*		*	*		
Seattle, Wash.			*	*		*		
Tacoma, Wash.			*	*				*
Madison, Wisc.	*			*				*
Milwaukee, Wisc.		*		*				*

to a greater degree. This is reasonable given that many cities try to impose various charges on suburban communities and commuters who consume city services. The columns headed "per capita total" refer to an allocation where the revenue burden is distributed on an equivalent per capita basis throughout the metropolitan area. "Per capita residual" implies that only the residual (county minus central city) is allocated on a relative population basis. For example, a central city with 60% of a metropolitan area's population will bear 60% of the residual.

Although one can certainly quarrel with the procedures described above, the results given in Table 4.4 are quite reasonable in terms of magnitude. The central focus of this study is not concerned with the testing of various allocations of expenditures and revenues between central cities and their suburbs. Until the data becomes available or better procedures are developed, such methods will always be subject to doubt. However, given these limitations of data and resources, it appears that these results are reasonably accurate in view of the focus of the study.

From the data in Table 4.4, it becomes possible to derive a measure of fiscal variation in terms of local expenditures and revenues between a central city and its suburbs. This measure will be defined as an index: PCXS/PCLRS ÷ PCXC/PCLRC, where PCXS and PCXC refer to per capita expenditures in the suburbs and central cities, respectively, and PCLRS and PCLRC are per capita local revenues for the same. The fiscal ratio for each of the metropolitan areas in the sample is given in Table 4.6. A value greater than unity implies that a net fiscal surplus is gained by suburban residents. Conversely, a value less than unity suggests that a fiscal advantage is realized by central city

residents. This occurs in nine metropolitan areas in the sample, and all but one are located in the sunbelt tier.

This measure of fiscal variation suffers from three difficulties. First, it does not explicitly consider the mix of services for the suburbs and central cities. This problem is mitigated somewhat by the allocation procedures for education and welfare (relative proportion of poor families), which are primary components of local government expenditures. Second, the measure of per capita local revenues does not consider what proportion is paid by businesses and may be more reflective of revenue effort rather than revenue burden. Finally, quality differentials in the provision of public goods and services are ignored.

Despite these drawbacks, the next section will analyze the stochastic equations in which the relative density of the three income groups derived in section 4.12 are regressed on the fiscal variation described above. Assuming that consolidation occurs between the central city and county governments, which eliminates the source of fiscal variation developed here, it will be possible to simulate the effects of this political process on the location of the three income groups. The sensitivity of this interaction will be explored in depth.

4.2 Empirical Results

4.21 The Total Sample

This section will analyze the regression equations for the entire sample. Although the discussion will be primarily concerned with the location equations, the fiscal equations also provide some interesting insights. In addition, the results from the consolidation simulation will be examined.

This study assumes that the middle class is the group most likely

Table 4.6
Fiscal Ratio

City	Fiscal Ratio	City	Fiscal Ratio
Birmingham, Al.	1.13	Jackson, Miss.	1.06
Mobile, Al.	.96	Omaha, Neb.	1.13
Phoenix, Az.	.94	Newark, N.J.	1.08
Tucson, Az.	.84	Jersey City, N.J.	1.32
Little Rock, Ark.	.85	Albuquerque, N.M.	.90
Fresno, Cal.	.84	Buffalo, N.Y.	1.38
Sacramento, Cal.	1.11	Rochester, N.Y.	1.29
San Diego, Cal.	.94	Syracuse, N.Y.	1.81
San Jose, Cal.	1.07	Greensboro, N.C.	1.19
Hartford, Conn.	1.04	Charlotte, N.C.	1.20
St. Petersburg, Fl.	1.02	Cleveland, Ohio	1.08
Savannah, Ga.	1.30	Cincinnati, Ohio	1.13
Columbus, Ga.	1.30	Dayton, Ohio	1.44
Chicago, Ill.	1.30	Tulsa, Ok.	.83
Peoria, Ill.	1.21	Pittsburgh, Pa.	1.20
Evansville, Ind.	1.46	Erie, Pa.	1.11
Des Moines, Iowa	1.04	Providence, R.I.	1.14
Wichita, Kan.	1.19	Houston, Tex.	1.28
Topeka, Kan.	1.08	Beaumont, Tex.	1.00
Louisville, Ky.	1.43	Corpus Christi, Tex.	.70
Flint, Mich.	1.23	Salt Lake City, Utah	1.28
Lansing, Mich.	1.20	Seattle, Wash.	1.15
Grand Rapids, Mich.	1.14	Tacoma, Wash.	1.05
Minneapolis, Minn.	1.39	Madison, Wisc.	1.10
Duluth, Minn.	1.44	Milwaukee, Wisc.	1.22

Table 4.7
Description of the Variables

CHGEMC	-	net absolute change in civilian employment in the central city, 1960-70
CHGEMS	-	net absolute change in civilian employment in the suburbs, 1960-70
DENC	-	persons per square mile in the central city
MANUFC	-	number of manufacturing employees in the central city in thousands
NFISCR	-	fiscal ratio multiplied by 100, lagged 3 years
NLCR	-	lower class index multiplied by 100
NMCR	-	middle class index multiplied by 100
NPBSCHC	-	percentage of blacks in central city public schools times 100
NPMCS	-	percentage of middle class in the suburbs times 100
NUCR	-	upper class index multiplied by 100
PCEXPC	-	per capita government expenditures in the central city, net of capital outlays
PCEXPS	-	per capita government expenditures in the suburbs, net of capital outlays
PCIGRC	-	per capita intergovernmental revenues in the central city
PCIGRS	-	per capita intergovernmental revenues in the suburbs
PCLRC	-	per capita local revenues in the central city
PCLRS	-	per capita local revenues in the suburbs
PCNETVAL	-	per capita net value of assessed property in the central city
PCNETVLS	-	per capita net value of assessed property in the suburbs
PCYC	-	per capita income in the central city
PCYS	-	per capita income in the suburbs

Table 4.7 (continued)
Description of the Variables

POPC	-	population in the central city in thousands
SIGRX	-	state intergovernmental expenditures in millions of dollars

to be influenced by Tiebout forces (metropolitan fiscal variations). Following the model in 3.3, the upper class location is assumed to be less influenced by such forces, depending on the relative strength of fiscal advantages, neighborhood quality and transportation costs. Alternatively, the lower class lacks the mobility which is a basic premise of the Tiebout hypothesis. The explanatory variables which were estimated for the middle class location were also utilized for the other two income groups. This procedure allows for greater insights across the income groups. In addition, the fiscal variables are assumed to be endogenous within the system. The measure of fiscal variation is taken as an identity (section 4.13), and its components are estimated with two-stage least squares.

The variables used in the model are listed and described in Table 4.7. Each of the percentages and indices were normalized so that the dependent and independent variables would be of the same magnitude. The concentration of employment is given by MANUFC, and decentralization is represented by CHGEMC and CHGEMS. Three proxies for neighborhood quality are utilized: DENC, NPMCS and NPBSCHC. Other proxies were developed for these characteristics, but they were either not significant or had the wrong sign.

The Regression Equations

The model was composed of nine equations. Table 4.8 gives the results for the location equations. The fiscal equations are listed in Table 4.9.

It is clear that the results from this model are consistent with the expectations derived from the theoretical framework in Chapter 3. From the equation for NMCR, it can be seen that the middle class is strongly influenced by the measure of fiscal variation and neighborhood characteristics. Specifically, the location of middle class residents is strongly determined by the fiscal advantage gained in that location. Neighborhood

quality (DENC) and race are also determinants of middle class location. The density-squared term is incorporated in order to correct for non-linearity problems in the equation. A log-log form could not be estimated because some of the values of CHGEMS were negative. A Goldfield-Quandt test was also performed to check for heteroskedastic influences, and it showed that this was not a problem on the basis of population.

One problem with this model is that the proxy for accessibility/decentralization (CHGEMS) was not significant in the middle class equation. The inclusion of an irrelevant variable does not bias the estimated coefficients, but the least-squares estimates are inefficient. However, this variable is significant for NLCR, and it was decided to incorporate it in each of the equations because it demonstrates the immobility of the lower class.

The regression results cange substantially for the upper class equation. The only significant variables in this equation are the proxies for neighborhood quality and race. The measure of fiscal variation is not significant, and this is somewhat surprising given that the upper class lives predominantly in the suburbs (see Table 4.2). A close inspection of the data shows that the magnitude of the upper class index is much greater than that for the middle class, and this can account for the result. Furthermore, the location of middle and upper classes is not consistent in fourteen of the cities in the sample. From the size of the standard error of the regression (63%), it is apparent that the determinants of upper class location are substantially different from those of the middle class.

It is interesting to note that all of the signs of the explanatory variables are reversed for the lower class relative to the middle class. This is expected given the lack of mobility which is indigenous to low-

income families, the oreintation of city governments to poverty services and the supply of low income housing in the city.

Some interesting insights are also provided in the fiscal equations (Table 4.9). One rather surprising result is that per capita income was not significant in the expenditure equation for the city. This implies that there may be resistance to increasing city expenditures, which include a higher proportion of poverty-related expenditures by those who would bear the increased tax burden. The size of the coefficients for intergovernmental revenues in both expenditure equations suggests that such revenues are more of a complementary source of revenues in the central cities and a relative substitute in the suburbs.

With respect to the equations for local revenues, the most interestint variables are CHGEMC and NPMCS. From the equation for PCLRC, it can be seen that the decline in employment in the central city, which is indicative of the flight of businesses to the suburbs, results in an increased revenue burden on the remaining businesses and population. In the equation for PCLRS, the impact of middle class residents on per capita local revenues is negative. This implies that as the concentration of middle class residents increases in a location, then the revenue effort per capita will be lessened. However, it should be noted that the per capita revenue estimates ignore the effects of business taxes.

Although the standard errors of the nonlocal revenue equations are rather high (33%), they are necessary for the proper econometric procedures discussed in section 2.2. The econometric difficulties in part result from the role of political considerations in the allocation of government grants. The equation for PCIGRC suggests that as central city population increases relative to its manufacturing base, nonlocal revenues will be increased. Alternatively, increases

Table 4.8
Location Equations - Total Sample

	Constant	NFISCR	CHGEMS	DENC	$DENC^2$	NPBSCHC	R^2
NMCR (11%)	15.1 (15.7)	0.62 (.16)	0.056 (.045)	0.006 (.002)	-3.05 E-07 (1.12 E-07)	0.41 (.12)	.66
NUCR (63%)	-35.47 (119.4)	-0.023 (1.19)	0.030 (.34)	0.038 (.016)	-1.11 E-06 (8.55 E-07)	1.72 (.94)	.49
NLCR (17%)	197.2 (17.75)	-0.70 (.18)	-0.084 (.051)	-0.008 (.002)	3.76 E-07 (1.27 E-07)	-0.23 (.14)	.62

Standard errors are in parentheses.

NFISCR = fiscal ratio.

CHGEMS = change in suburban civilian employment.

DENC = population density in the city.

NPBSCHC = race.

Fiscal Equations – Total Sample

	Constant	PCIGRC	DENC	PCYS	PCIGRS	PCNET VAL	PCEXPC	PCNET VLS	PCEXPS	NPMCS	SIGRX	POPC÷ MANUFC	PCYS÷ PCYC x100	CHGEMC	R^2
PCEXPC (17%)	39.3 (28.9)	1.64 (.25)	0.01 (.002)												.62
PCEXPS (16%)	52.94 (30.01)			0.023 (.008)	1.1 (.16)										.62
PCLRC (14%)	33.5 (21.9)					0.0085 (.004)	0.68 (.08)							-0.19 (.13)	.73
PCLRS (17%)	104.4 (27.7)							0.006 (.003)	0.47 (.10)	-0.095 (.005)					.57
PCIGRC (33%)	67.4 (10.7)										0.025 (.005)	1.0 (.6)			.35
PCIGRS (33%)											0.035 (.004)		0.53 (.05)		.35

Standard errors in parentheses.

in per capita income in the suburbs relative to the central cities are also positively related to the increase in nonlocal revenues. This suggests that some funding formulas are biased toward the growing areas.

The Simulation

In order to test the sensitivity of residential location to fiscal variations within a metropolitan area, a simulation was performed whereby the effects of the fiscal variation were eliminated. It is assumed that a consolidated government would equalize expenditures and revenue effort across a metropolitan area. Therefore, the source of fiscal variation which is developed in this model is eliminated with the establishment of metropolitan consolidation.

The percentage distribution of each income group before and after consolidation is given in Table 4.10. Although the direction of the results was expected a priori, the magnitude was somewhat surprising. For example, twelve central cities had a greater relative concentration of middle class households before the simulation. On an ex post basis, this was true for all central cities. Furthermore, thirty-one of the middle class indicies were less than .50. This implies that for sixty percent of the sample, the simulation produced results in which the relative concentration of middle class families in the central city was twice that of suburbs. It should be noted that the simulation assumes costless moves and instantaneous adjustments. This is clearly responsible for much of the simulated movement.

The sensitivity of the upper income class was one of a much more stable magnitude, and the simulation produces no clear-cut pattern of location. In twenty-six metropolitan areas, there was a tendency toward a greater concentration in the suburbs, but twenty-four had a greater tendency toward the central city. This is consistent with the hypothesis that the upper class may not be strongly influenced by fiscal variations

Table 4.10
Simulation Results - Comparative Locational Indices
Total Sample

	Middle Class		Upper Class		Lower Class	
	Ex Ante	Ex Post	Ex Ante	Ex Post	Ex Ante	Ex Post
Birmingham, Al.	1.07	.57	1.71	1.80	.75	1.59
Mobile, Al.	.98	.42	.51	.97	1.20	1.75
Hartford, Conn.	1.52	.66	2.92	2.85	.53	1.42
Savannah, Ga.	1.38	.59	1.23	2.04	.62	1.57
Chicago, Ill.	1.37	.71	2.43	3.64	.51	1.33
Evansville, Ind.	1.08	.38	1.56	1.08	.63	1.71
Des Moines, Iowa	1.19	.35	1.47	.87	.77	1.73
Louisville, Ky.	1.45	.56	1.64	2.05	.70	1.53
Flint, Mich.	1.27	.57	1.34	2.10	.71	1.54
Minneapolis, Minn.	1.41	.53	2.37	2.07	.52	1.50
Duluth, Minn.	1.13	.24	.58	.20	1.01	1.86
Newark, N.J.	1.62	.62	7.53	3.96	.52	1.53
Jersey City, N.J.	1.05	.43	1.10	3.34	.86	1.67
Buffalo, N.Y.	1.47	.60	2.21	2.57	.64	1.47
Rochester, N.Y.	1.45	.59	3.06	2.42	.45	1.47
Syracuse, N.Y.	1.45	.53	1.32	2.18	.65	1.53
Cleveland, Ohio	1.48	.72	5.16	3.14	.51	1.37
Cincinnati, Ohio	1.52	.58	1.66	2.10	.62	1.52
Dayton, Ohio	1.37	.60	2.73	2.27	.60	1.50
Pittsburgh, Pa.	1.34	.59	1.35	2.68	.76	1.47
Erie, Pa.	1.04	.47	1.34	1.86	.80	1.59
Providence, R.I.	1.20	.53	1.20	2.53	.69	1.52
Beaumont, Tex.	1.01	.39	.47	.86	1.03	1.77
Salt Lake City, Utah	1.28	.33	1.08	.71	.61	1.74
Seattle, Wash.	1.21	.52	1.14	1.81	.73	1.52
Milwaukee, Wis.	1.22	.54	3.79	2.23	.64	1.53
Phoenix, Az.	.96	.34	1.04	.59	1.04	1.75
Tucson, Az.	.91	.35	1.50	.84	.89	1.74
Little Rock, Ark.	.88	.42	.34	1.05	1.14	1.72
Fresno, Cal.	.90	.40	1.05	1.18	1.10	1.69
Sacramento, Cal.	1.20	.38	1.07	.87	.82	1.73
San Diego, Cal.	1.02	.35	.75	.62	1.01	1.74
San Jose, Cal.	.98	.38	2.02	.84	.91	1.67
St. Petersburg, Fl.	1.07	.47	1.06	1.40	.93	1.64
Columbus, Ga.	1.18	.40	.69	.96	.91	1.75
Peoria, Ill.	1.07	.39	.52	1.06	.99	1.72
Wichita, Kan.	1.11	.37	.97	.96	.82	1.73
Topeka, Kan.	1.10	.33	.91	.73	.88	1.77
Lansing, Mich.	1.00	.40	2.28	1.16	.89	1.68
Grand Rapids, Mich.	1.20	.44	1.13	1.36	.80	1.65
Jackson, Miss.	1.07	.51	.53	1.50	.99	1.65
Omaha, Neb.	1.22	.42	1.54	1.35	.73	1.67

Table 4.10 (continued)
Simulation Results - Comparative Locational Indices
Total Sample

	Middle Class		Upper Class		Lower Class	
	Ex Ante	Ex Post	Ex Ante	Ex Post	Ex Ante	Ex Post
Albuquerque, N.M.	.95	.32	.46	.72	1.44	1.76
Greensboro, N.C.	.91	.42	.56	1.09	1.14	1.71
Charlotte, N.C.	1.28	.47	1.06	1.35	.77	1.66
Tulsa, Ok.	.85	.31	.31	.55	1.19	1.81
Houston, Tex.	1.26	.39	.83	.81	.80	1.69
Corpus Christi, Tex.	.81	.29	.57	.47	1.39	1.82
Tacoma, Wash.	.99	.37	1.20	.92	.89	1.72
Madison, Wisc.	.97	.34	.97	.87	1.04	1.73

in a metropolitan area, which is also indicated by the equation for NUCR.

Finally, the simulation for low income families makes the Tiebout assumption of perfect mobility. The results from this simulation indicate that the low income class would essentially trade location with the middle class. However, this result is not really accurate. The poor may be able to receive a net fiscal advantage by locating in the central city, particularly with public transportation and the supply of low-skilled jobs and low income housing concentrated there. The equation for NLCR does not explicitly consider this.

This analysis tends to support the implications of the Tiebout hypothesis that residential location is in part determined by fiscal variations. Moreover, it is the middle class which is primarily influenced in its locational decisions. One must be quite skeptical of the magnitude of the response, though; it appears to be much too large. It is also interesting to note that the consolidation simulation produces a distribution of income groups within a metropolitan area that is similar to underdeveloped countries, whereby upper income families live in the central city and the poor on the periphery.

The next two sections will analyze the empirical results obtained from stratifying the sample into declining and growing areas. The results contrast sharply with those presented here. This allows for considerable insights into the model.

4.22 Declining Areas

The Regression Equations

Of the fifty metropolitan areas in the sample, twenty-six had central cities which declined in population from 1960-1970. The use of cross-section data always raises questions with respect to the sample.

Table 4.11
Location Equations - Declining City

	Constant	NFISCR	CHGEMS	DENC	$DENC^2$	NPBSCHC	R^2
NMCR (11%)	55.1 (35.2)	0.25 (.28)	0.043 (.058)	0.0075 (.0027)	-3.6 E-07 (1.39 E-07)	0.415 (.20)	.54
NUCR (62%)	-23.53 (320.8)	-0.53 (2.56)	-0.23 (.52)	0.044 (.025)	-1.46 E-06 (1.26 E-06)	3.08 (1.82)	.46
NLCR (19%)	137.37 (31.74)	-0.22 (.25)	-0.07 (.05)	-.008 (.002)	3.85 E-07 (1.25 E-07)	-0.15 (.18)	.60

Standard error in parentheses

NFISCR = fiscal ratio.

CHGEMS = change in suburban civilian employment.

DENC = population density in the city.

NPBSCHC = race.

Table 4.12

Fiscal Equations - Declining Cities

	Constant	PCIGRC	DENC	PCYS	PCIGRS	PCNET VAL	PCEXPC	CHGEMC	PCNET VLS	PCEXPC	NPMCS	SIGRX	POPC÷ MANUFC	PCYS÷ PCYC x100	R^2
PCEXPC (18%)	68.8 (44.6)	1.34 (.39)	0.01 (.002)												.58
PCEXPS (16%)	66.2 (43.3)			0.028 (.012)	0.78 (.20)										.58
PCLRC (10%)	33.85 (23.76)					0.006 (.004)	0.73 (.08)	0.091 (.22)							.82
PCLRS (17%)	108.3 (50.7)								0.0075 (.004)	0.3 (.16)	-0.004 (.01)				.43
PCIGRC (35%)	74.1 (22.1)											0.014 (.007)	0.98 (1.8)		.14
PCIGRS (33%)												0.036 (.006)		0.48 (.06)	.55

The results in the preceding section indicate that the Tiebout hypothesis is verified in terms of the consolidation simulation for the middle class. Therefore, it is appropriate to stratify the sample on the basis of population growth (decline) in the central city. This will indicate if the Tiebout hypothesis is viable across metropolitan areas with different characteristics.

This section will analyze declining metropolitan areas. The same equations estimated in the preceding section are used here. The regression equations are given in Tables 4.11 and 4.12.

The most interesting result from this sample is that the measure of fiscal variation is no longer significant in the equation for the middle class. Since this variable is significant at the 99% level for the total sample, this result is somewhat surprising. However, one should recall that the declining cities are located primarily in the north and east and have been havens for poor immigrants in the post-war era. This result is justified for two reasons. First, the primary incentives for middle class location in these areas may be neighborhood quality and race, and this is indicated by the significance of DENC and NPBSCHC. The central cities in the north and east have suffered the most in terms of deteriorating residential areas and concentrations of the poor. Second, these central cities receive large amounts of intergovernmental revenues. Therefore, the measure of fiscal variation used in this study may not accurately reflect the relative fiscal positions of the central cities and the suburbs.

The equations for the upper income and lower income groups do not change substantially. The upper class reacts solely to central city density and race, and this is consistent with the prior results. However, the size of the standard error (62%) precludes any further analysis. With respect to the lower class, the results are essentially

the same as for the entire sample.

Similar conclusions are indicated by the fiscal equations. The coefficient for nonlocal revenues drops substantially in the expenditure equation for both central cities and suburbs. This indicates that intergovernmental revenues comprise a greater proportion of outright grants rather than matching funds for public works in declining areas. Otherwise, the equations are consistent with those in the previous section.

The Simulation

The results from the consolidation simulation are given in Table 4.13. Although the middle class is again viewed as moving back into the central city, the magnitude is substantially less than for the total sample. This is consistent with the insignificance of the fiscal variation variable in the middle class equation. In contrast to the previous simulation, only eleven central cities (out of the twenty-six metropolitan areas) had a greater relative concentration of middle class families.

The simulated movement of the upper and lower classes is also dampened in declining areas. Whereas the middle class had a trend away from the suburbs for each metropolitan area in the subsample, the upper income group had a mixed pattern of movement. In seventeen areas the upper class had a relative increase in the suburbs. The opposite was true for only nine of the cities. However, the index was greater than unity for all but two areas (versus three *ex ante*), which points out that the upper class would tend to remain in the suburbs.

The simulated index for the low income group increases for each area in the sample, and the values for the most part tend toward unity. Since the simulated values for the middle class approach unity

Table 4.13
Simulation Results - Comparative Locational Indices
Declining Central Cities

	Middle Class		Upper Class		Lower Class	
	Ex Ante	Ex Post	Ex Ante	Ex Post	Ex Ante	Ex Post
Birmingham, Al.	1.07	1.01	1.71	2.73	.75	1.02
Mobile, Al.	.98	.84	.51	1.74	1.20	1.18
Hartford, Conn.	1.52	1.12	2.92	3.61	.53	.84
Savannah, Ga.	1.38	1.04	1.23	3.08	.62	1.00
Chicago, Ill.	1.37	1.15	2.43	3.81	.51	.76
Evansville, Ind.	1.08	.82	1.56	1.50	.63	1.10
Des Moines, Iowa	1.19	.79	1.47	1.22	.77	1.13
Louisville, Ky.	1.45	1.02	1.64	2.70	.70	.94
Flint, Mich.	1.27	1.03	1.34	2.88	.71	.95
Minneapolis, Minn.	1.41	.98	2.37	2.32	.52	.89
Duluth, Minn.	1.13	.66	.58	.43	1.01	1.26
Newark, N.J.	1.62	1.08	7.53	5.03	.52	.95
Jersey City, N.J.	1.05	.88	1.10	3.90	.86	1.06
Buffalo, N.Y.	1.47	1.07	2.21	3.22	.64	.87
Rochester, N.Y.	1.45	1.05	3.06	3.00	.45	.88
Syracuse, N.Y.	1.45	.99	1.32	2.74	.65	.92
Cleveland, Ohio	1.48	1.18	5.16	3.93	.51	.79
Cincinnati, Ohio	1.52	1.03	1.66	2.87	.62	.94
Dayton, Ohio	1.37	1.06	2.73	3.07	.60	.92
Pittsburgh, Pa.	1.34	1.06	1.35	3.35	.76	.87
Erie, Pa.	1.04	.93	1.34	2.34	.80	.97
Providence, R.I.	1.20	1.00	1.20	3.06	.69	.90
Beaumont, Tex.	1.01	.81	.47	1.55	1.03	1.19
Salt Lake City, Utah	1.28	.76	1.08	.92	.61	1.14
Seattle, Wash.	1.21	.97	1.14	2.08	.73	.92
Milwaukee, Wis.	1.22	1.01	3.79	2.85	.64	.92

from the opposite direction, it is possible that convergence with respect to residential location for the middle and lower income groups would occur. Consolidation would appear to be a counterforce to residential segregation in declining areas.

This analysis casts some doubts on the efficacy of the Tiebout hypothesis. The regression results suggest that middle class families are escaping from the problems associated with declining central cities in terms of deteriorating neighborhoods and the concentration of poverty rather than to gain a fiscal advantage. This is reinforced by the insignificance of the accessibility proxy in the middle class equation, which indicates that central city employment still predominates in these areas.

The next section will analyze the model with respect to metropolitan areas with growing central cities. Given the results obtained so far, it can be expected that the analysis for growing areas will indicate significant differences vis-a-vis declining areas. These issues are discussed below.

4.23 Growing Areas

The Regression Equations

The equations for those metropolitan areas which had central cities with increasing populations are estimated with the same variables and econometric procedures as in the previous two sections. The sample consists of twenty-four metropolitan areas, and the results are given in Tables 4.14 and 4.15.

Clearly, there are substantial differences between the equations for declining and growing areas. This is best illustrated in the equation for the middle class. Middle class location is strongly correlated

with the measure of fiscal variation. Alternatively, the proxies for neighborhood quality and race were not significant in the equation. This is the opposite result obtained for middle class location in declining areas (Table 4.11). The insignificance of DENC and NPBSCHC in the NMCR equation is justified for two reasons. First, the central cities which had population increases have substantially less population density than those with population declines. This conclusion was reached in section 4.11. The diminished differential between density in the central cities and the suburbs implies that it is unlikely to be a determinant of location. Second, the number of blacks in these cities is relatively small compared to the declining cities. This was also pointed out in section 4.11. Thus, it is unlikely that race would be an important determinant of location.

The equations for the upper and lower classes are somewhat less interesting. It is apparent that the upper class does not respond to the same determinants of location as the middle class. This has become evident throughout the analysis, and it suggests that the Tiebout hypothesis is viable primarily with respect to the middle class.

Just as the upper class can select any location due to its high income, the lower class is relatively immobile because of low income. The determinants of location for the lower class are reversed in comparison to the middle class. Therefore, the explanatory variables used in the equation for NLCR are not valid. Neither the measure of fiscal variation nor the proxies for neighborhood quality and accessibility can be viewed as determinants of lower class location. The former is viable only with respect to those households with average or above average incomes. The other proxies are locational attributes for which the rich can effectively outbid the poor. Thus, this equation does not provide much insight.

The fiscal equations are somewhat more insightful. In the expenditure equations it appears that the variables which were significant for the total sample are not adequate in growing areas. Some population variables such as growth rates would likely be more reasonable. However, such variables were not significant for the total sample.

The equations for local revenues deteriorated substantially in this subsample. One surprising result is that the net valuation of property was not significant. A plausible justification for this phenomenon may be that the south and west have a relatively smaller manufacturing base, a primary component of property values. Net valuation is likely to be less of a determinant for explaining the variation in local revenues.

However, the impact of the middle class on suburban local revenues is very important. In section 4.12, it was stated that the middle class is somewhat more evenly distributed between the central cities and suburbs in the growing areas. Thus, the negative impact of the middle class on local revenues in the suburbs may be the result of tax competition between the two jurisdictions to attract this income group.

The Simulation

The consolidation simulation for this subsample is given in Table 4.16. In contrast to the declining areas, both the middle and upper classes have an extreme tendency to locate in the central city when the source of fiscal variation is eliminated. This was true for each area in the subsample for the middle class, and all but three cities for the upper income group. These results suggest that the Tiebout hypothesis is quite valid in expanding metropolitan areas. However, the

Location Equations - Growing Cities

	Constant	NFISCR	CHGEMS	DENC	$DENC^2$	NPBSCHC	R^2
NMCR (9%)	53.0 (34.4)	0.73 (.15)	0.063 (.073)	-0.02 (.022)	3.49 E-06 (3.52 E-06)	0.089 (.185)	.64
NUCR (39%)	-57.09 (141.1)	0.41 (.62)	0.495 (.298)	0.04 (.09)	-3.49 E-07 (1.45 E-05)	-1.15 (.76)	.54
NLCR (13%)	179.86 (50.17)	-0.757 (.22)	-0.145 (.106)	0.0085 (.033)	-2.5 E-06 (5.14 E-06)	-0.046 (.272)	.58

NFISCR = fiscal ratio.

CHGEMS = change in suburban civilian employment.

DENC = population density in the city.

NPBSCHC = race.

Table 4.15
Fiscal Equations - Growing Cities

	Constant	PCIGRC	DENC	PCYS	PCIGRS	PCNET VAL	PCEXPC	CHGEMC	PCNET VLS	PCEXPC	NPMCS	SIGRX	POPC ÷ MANUFC	PCYS ÷ PCYC x100	R^2
PCEXPC	56.22	1.42	0.113												
(15%)	(37.68)	(.19)	(.011)												.74
PCEXPS	57.66			0.012	1.4										
(18%)	(47.45)			(.015)	(.22)										.66
PCLRC	55.48					0.0088	0.52	0.071							
(16%)	(31.03)					(.0072)	(.10)	(.21)							.62
PCLRS	88.9								0.0038	0.683	-0.015				
(17%)	(38.6)								(.005)	(.11)	(.008)				.68
PCIGRC	66.68											0.036	0.611		
(29%)	(15.54)											(.007)	(.752)		.56
PCIGRS												0.033		0.616	
(32%)												(.006)		(.08)	.54

Standard error in parentheses.

Table 4.16
Simulation Results - Comparative Locational Indices
Growing Central Cities

	Middle Class		Upper Class		Lower Class	
	Ex Ante	Ex Post	Ex Ante	Ex Post	Ex Ante	Ex Post
Phoenix, Az.	.96	.28	1.04	.56	1.04	1.77
Tucson, Az.	.91	.25	1.50	.71	.89	1.79
Little Rock, Ark.	.88	.27	.34	.11	1.14	1.82
Fresno, Cal.	.90	.28	1.05	.84	1.10	1.73
Sacramento, Cal.	1.20	.26	1.07	.46	.82	1.80
San Diego, Cal.	1.02	.30	.75	.52	1.01	1.76
San Jose, Cal.	.98	.30	2.02	1.13	.91	1.67
St. Petersburg, Fl.	1.07	.31	1.06	.81	.93	1.69
Columbus, Ga.	1.18	.27	.69	.08	.91	1.86
Peoria, Ill.	1.07	.25	.52	.54	.99	1.80
Wichita, Kan.	1.11	.24	.97	.50	.82	1.81
Topeka, Kan.	1.10	.25	.91	.36	.88	1.84
Lansing, Mich.	1.00	.29	2.28	.89	.89	1.72
Grand Rapids, Mich.	1.20	.33	1.13	1.01	.80	1.66
Jackson, Miss.	1.07	.28	.53	.12	.99	1.79
Omaha, Neb.	1.22	.33	1.54	1.02	.73	1.66
Albuquerque, N.M.	.95	.24	.46	.57	1.44	1.82
Greensboro, N.C.	.91	.27	.56	.17	1.14	1.82
Charlotte, N.C.	1.28	.28	1.06	.36	.77	1.77
Tulsa, Ok.	.85	.28	.31	.02	1.19	1.87
Houston, Tex.	1.26	.30	.83	.87	.80	1.70
Corpus Christi, Tex.	.81	.26	.57	.14	1.39	1.87
Tacoma, Wash.	.99	.26	1.20	.70	.89	1.77
Madison, Wis.	.97	.25	.97	.84	1.04	1.77

sensitivity of location appears to be much too large.

The simulated movement of the lower class is consistent with prior runs. In this subsample, the trend toward location in the suburbs is of the same magnitude as the middle and upper classes. In contrast to the simulated residential integration in declining areas, income segregation by location is the result indicated in Table 4.16.

The model estimated in section 4.2 has been tested in a comprehensive manner. First, location was estimated for three income groups, with particular emphasis on the determinants of middle class location. Second, the sample was divided into growing and declining areas, and this allowed for considerable insights into possible biases which a particular sample may produce.

The next section will discuss some of the limitations of the model. First, weakness in the measure of fiscal variation will be analyzed. Second, the problem of misspecification when the sample is disaggregated will be addressed. Finally, improvements in the model will be suggested.

4.3 Limitations of the Model

The Fiscal Measure

It was expected, *a priori*, that the sign of the measure of fiscal variation would be positive for the location of middle and upper income groups. Although these expectations were met for the middle class in areas with growing central cities and the total sample, the variable was insignificant for the upper class in all tests. Since the variable was significant and negative for the lower class, it cannot be viewed as a general measure of fiscal advantages.

There are two possible reasons for this. First, it can be argued that the upper class would respond in part to quality differentials with

respect to public services. This could be particularly valid with respect to education and property protection (police and fire services). However, this reasoning could also be applied to the middle class, for whom the variable was significant..

The solution to this apparent inconsistency may be found in the theoretical analysis of Chapter 3. One of the primary conclusions drawn from the individual utility functions was that the components of location could become inferior goods under certain assumptions. A necessary condition for this to occur was that the marginal utility of public goods approached zero for the rich. If this assumption is reasonably accurate, then it helps to explain the insignificance of fiscal variation in the upper class location equations. Although the data indicates that the upper class tends to concentrate in the suburbs, their pattern of location was not consistent with the middle class on a city by city basis. This provides some credence to the explanation cited above.

The second reason is that the measure of fiscal variation is purely monetary, and it is composed of per capita estimates of revenues and expenditures. By definition, these estimates represent a per person average. In terms of revenue burdens, the upper class is likely to pay more than this average whereas the poor would tend to pay less. This incidence is not captured in this measure. Since the middle class benchmark used in Chapter 4 was white median family income. the middle class would be expected to respond to fiscal advantages in per capita terms. A more accurate measure for the upper and lower income groups must take account of their differential burdens, and a similar argument could be made with respect to expenditures. Therefore, the measure of fiscal variation used in this study may not be viable for the upper and lower classes.

One should recall from Chapter 2 that Bradford and Kelejian's measure of fiscal variation did incorporate some crude incidence assumptions. Using Gillespie's estimates of the incidence of expenditures and revenues, they assume that the nonpoor pay 2.5 times as much in revenues as the poor. It seems quite possible that this procedure could be further refined, and more accurate estimates of the fiscal variation by income groups could be developed.

The Problem of Misspecification

With the exception of the accessibility variable, the proxies for neighborhood quality, race and fiscal variations were significant in the middle class location equation for the total sample. The results change substantially, however, when the sample was divided into growing and declining areas. In the former, only the measure of fiscal variation was significant. Alternatively, the measure of fiscal variation was not significant in declining areas, but neighborhood quality and race were statistically verified. This suggests that different locational forces are at work in metropolitan areas with varying characteristics. The model is accordingly misspecified within the subsamples.

This problem raises substantial doubts with respect to the use of cross-section models in the analysis of Tiebout-induced mobility. Cross-section data is appropriately used in conjunction with equilibrium situations. Although the Tiebout model does represent an equilibrium in a normative sense, this is clearly not appropriate in the "real world". Imperfect knowledge, moving costs and specific locational attributes tend to produce a disequilibrium in terms of location.

The argument that locational disequilibrium is responsible for the

poor subsample results is intuitively logical. It is quite likely that declining and growing cities would have substantially different causes of the disequilibrium. For example, there is a significant dichotomy of racial and neighborhood characteristics between central cities and their suburbs in declining areas. These factors, however, are relatively homogeneous in the growing metropolitan areas, and accordingly, the fiscal variations would be the likely cause of locational disequilibrium.

This reasoning could be viewed as a cause for the extreme results of the consolidation simulation for the total sample. The estimates of expenditures and revenues in Table 4.4 are likely to be characterized by errors in measurement. Therefore, the subsample equations for the fiscal variables may bias those for the total sample. Since the measure of fiscal variation is composed of these fiscal variables, the coefficient for fiscal variation, and accordingly, the simulation, may be biased as well. In order to check for this possibility, the reduced form coefficients for the fiscal variables were calculated for the total sample, declining and growing areas. By inspection, it was clear that the coefficients for the total sample were not biased in any one direction. Thus, the poor simulation results can be attributed primarily to the assumptions of costless moves and instantaneous adjustments.

For these reasons, it is apparent that time-series analysis would be more appropriate in order to estimate the effects of the Tiebout hypothesis on location. As stated in Chapter 3, the power of the model to explain a disequilibrium process is questionable. Time-series would increase the explanatory power of the model in two respects. First, it would be possible to incorporate supply factors into the model. These would include changes in the supply of jobs, housing and resources over time. Second, it would be possible to simulate over the sample period

and forecast future location by income groups between the city and the suburbs. This would provide important information for local public officials.

A second source of misspecification results from the use of the same explanatory variables for each of the three income groups. The purpose of this method was to ascertain if locational determinants varied by income group. From the regression results, it is apparent that the determinants of lower and upper class location are substantially different than those for the middle class. Moreover, it was suggested that the measure of fiscal variation may also not be appropriate for each group.

For these reasons, the location equations for each of the income groups should be estimated independently. A measure of fiscal variation should be included in each of the location equations. From the preceding discussion, it is apparent that the measure would have to be tailored to each income group. Therefore, assumptions with respect to both revenue and expenditure incidence would have to be determined for the income groups in each jurisdiction. When these conditions are met, the consolidation simulation could still be tested by suppressing the coefficients for the measures of fiscal variation. By estimating the location equations independently, the accuracy of the model would hopefully be enhanced.

It should be noted that the misspecification within the subsample and income groups in this model was intentional, and two primary conclusions results from it. First, it was demonstrated that cross-section models are inappropriate for analyzing the Tiebout hypothesis. Second, the determinants of location were found to vary by income.

With respect to the literature, these results are quite significant. The next chapter will summarize the primary conclusions of the theoretical

and empirical models developed in this study. The conclusions will then be placed in the context of the consolidation and Tiebout literature that was reviewed previously.

CHAPTER 5

A DISCUSSION OF PRIMARY CONCLUSIONS

5.1 Introduction

The purpose of this study has been to investigate the degree to which fiscal variations in metropolitan areas influence residential location. This represents a direct test of the Tiebout hypothesis, which states that households will reside in the community that provides the mix of public services and taxes best suited to their tastes and preferences. Although the Tiebout hypothesis was originally developed to demonstrate the existence of a quasi-market in the local public sector, the rather restrictive assumptions of the model have cast substantial doubts on its validity in this context. However, the issue of fiscally-induced residential location remains important in view of the continuing trends of suburban decentralization and central city deterioration.

The sensitivity of residential location to fiscal variations was tested by means of a metropolitan governmental consolidation simulation. As local governments have attempted to cope with the dilemma of increasing demands for public services coupled with diminishing sources of revenues and/or resistance to higher taxes, the concept of governmental consolidation has received a great deal of attention. The proponents of consolidation assume that the dual problems of providing adequate public services and raising the necessary revenues to pay for them are metropolitan in nature. This study did not endeavor to measure the benefits

and costs of metropolitan consolidation. Rather, it applied this proposed public policy to an important economic theoretical and empirical issue, that of fiscally-induced migration.

This chapter will place the theoretical model of Chapter 3 and the empirical results of Chapter 4 within the context of the literature. Theoretical revisions of the Tiebout hypothesis and empirical tests were comprehensively reviewed in Chapter 2. One should recall that the theoretical studies were primarily directed to the efficiency aspect of the Tiebout hypothesis. On the other hand, the empirical models have for the most part attempted to estimate the magnitude of fiscally-induced migration.

The theoretical studies were quite successful in clarifying the limitations of the Tiebout model with respect to local government efficiency. In Chapter 3 a model was developed that incorporated the government sector into the household's utility function. This permitted an examination of the impact of metropolitan fiscal variation on utility-maximizing location. It represents an extension of the theoretical revisions, and it is directly related to the empirical research. In addition, the impact of metropolitan consolidation on households will be analyzed within the framework of the model in Chapter 3. These issues are discussed below.

5.2 Residential Location and the Tiebout Hypothesis

The results from the utility function in Chapter 3 clearly demonstrate the usefulness of the model in the context of the Tiebout hypothesis. However, it should be recalled that model is limited in two respects. First, it assumes that voter preferences will be revealed through the mechanism of migration rather than at the polls. Second,

the model does not specify how the government formulated its budget in the first place. Despite these drawbacks, the utility function does link accessibility models of residential location to the consequences of fiscally-induced migration.

Theoretical Revisions

The utility function can be used to analyze the efficiency aspects of the Tiebout hypothesis. These can be defined in terms of three primary issues: the possible effects of immigrants into a community, the use of the property tax as an efficient pricing mechanism for public goods and the effects of fiscal zoning. These issues are discussed below.

The first problem is to examine the impact of inmigrants on individual utility. The literature in 2.1 reached the general conclusions that the individual will be worse off if the increased sharing of the tax burden is offset by larger congestion costs. Buchanan and Goetz point out that a necessary condition for this to occur is the existence of "impure public goods". The Samuelsonian definition of public goods states that the marginal costs of an additional consumer are zero. If this characteristic was true for all public services, then the inmigrants could not impose an increased burden on an individual. Hamilton and Hirsch and Margolis argue that if an inmigrant consumes less than the average housing in a community (assuming the property tax is the sole source of revenue), costs will be passed on to the residents.

The utility function demonstrates that inmigrants affect the individual household through the tax-price that is borne. It was specified that the price of housing was a function of location and the fiscal variation. Each of these components would be capitalized in the price of housing. The tax-price of public goods also was a function of

location. Therefore, the key elements of the model are:

$\frac{\partial P_H}{\partial FV}$ FV'(k) and P_G'(k).

If a household moves into an area and consumes less than the average housing, costs will be imposed on the present resident. The resident will bear a higher tax-price. Assuming constant or increasing costs in the provision of public services, the inmigrant will consume more in services than he will pay in taxes. The excess costs must be borne by the remaining residents, and this implies that P_G'(k) will increase. This cost also manifests itself in the negative capitalization on the price of the resident's home. The increased tax burden will reduce any fiscal advantage that the resident enjoys (FV'(k) declines). Since the sign of $\frac{\partial P_H}{\partial FV}$ is positive, this suggests that the value of the home will be reduced. The opposite would of course be true if the inmigrant consumed more than the average housing.

The utility function in Chapter 3 also explicitly considers the efficiency of the property tax. If it is an efficient pricing mechanism, then the fiscal variation will disappear. Therefore, $\frac{\partial P_H}{\partial FV}$, FV'(H) and FV'(k) would all be equal to zero. The tax-price would be proportional to the consumption of housing, and the price of housing would not be capitalized by fiscal variations. This is equivalent to Hamilton's model, which also requires fiscal zoning and jurisdictional segregation by income.

However, Hirsch and Margolis' model is more consistent with the results of Chapter 3. They demonstrate that the property tax is not an efficient pricing mechanism, and that capitalization does occur. Furthermore, they suggest that locational reversals would occur in the construction of single and multifamily housing. This is equivalent to

the location decisions of upper income households, where the attributes of location are inferior goods. Thus, the conclusions from the theoretical model severely constrain the efficiency of the property tax and the liklihood of fiscal zoning.

Empirical Models

The empirical models based on the Tiebout hypothesis fall into two major categories. The first group attempted to estimate the impact of tax-expenditure capitalization on property values. These studies assumed that Tiebout-induced mobility was the cause of capitalization, and they include Oates, Pollakowski and Edel and Sclar.

The second category is concerned with the effects of fiscal variations on residential location. The studies by Aronson and Schwartz, Bradford and Kelejian and Haurin and Tolley attempt to directly estimate the magnitude of fiscally-induced migration. These models have essentially rejected the notion of the Tiebout hypothesis as an efficiency mechanism, and accordingly, the theoretical revisions were quite helpful in demonstrating the importance of the migration issue.

The capitalization of fiscal variables is crucial to the model in Chapter 3. The measure of fiscal variation is defined in terms of expenditures and taxes, and both are assumed to vary by location. Therefore, $FV'(k)$, $P_G'(k)$ and $G'(k)$ are all related to the models discussed above.

The analysis in Chapter 3 demonstrated that both $FV'(k)$ and $G'(k)$ were important determinants for the income effect of location. If $FV'(k)$ was positive and large, and $G'(k)$ was relatively small, then the attributes of location could become an inferior good. However, it is interesting to relate the magnitude of $FV'(k)$ to the models of Oates and Edel and Schlar. Oates found evidence of significant tax-expenditure

capitalization in his cross-section model. This implies that FV'(k) was large for his sample. Alternatively, Edel and Sclar argued that the capitalization of property values was declining over time, and FV'(k) would be relatively small in this case. It should be noted that Edel and Sclar used a different sample, however.

The implications of this discussion provide some valuable insights into Tiebout models. First, it is apparent that the magnitude of the fiscal variation will differ substantially between metropolitan areas with contrasting characteristics. This was a major conclusion derived from the empirical model in Chapter 4. The second implication is that the degree of fiscal variation will vary over time. Although the Tiebout hypothesis is a model of demand articulation, supply adjustments are an important factor that have been ignored in the research. This results from the total reliance on cross-section models, a criticism that was also discussed in Chapter 4.

The utility function was quite explicit with respect to the impact of fiscal variation on residential location. If housing services and location are normal goods, then _ceteris paribus_, the household will locate where it receives a fiscal advantage. This was the conclusion reached in the studies by Aronson and Schwartz and Bradford and Kelejian. However, these models did not fully specify the association between housing services, public goods and their respective prices. The utility function in Chapter 3 accomplished this by expanding the definition of location to include accessibility, neighborhood quality and jurisdictions.

Haurin and Tolley develop a model that is based on the assumption that upper income households gain a fiscal advantage by locating in the suburbs. The location of upper income households in the central city

results in a social welfare loss. This model is consistent with those discussed above because it only considers location to be a normal good.

It was demonstrated, however, that the attributes of location could become an inferior good, and this implies that an upper income household would reside in the central city under certain assumptions. Haurin and Tolley argue that the suburbs represent the optimal location for all upper income households. A critical assumption is that consumption of the public good is ubiquitous throughout the metropolitan area. This is equivalent to a Samuelsonian public good. However, one should recall that $G'(k) = 0$ was a sufficient condition for location to be an "inferior good". Since $G'(k) = 0$ is consistent with a pure public good, the restrictiveness of Haurin and Tolley's model is quite apparent in terms of the conclusions of the utility function in Chapter 3.

Consolidation

The discussion of the consolidation literature in Chapter 1 was concerned primarily with the efficiency and equity issues of consolidated governments. The conclusion reached from this discussion was that these issues are far from being resolved. However, the implications of consolidation are well known. Tax rates and expenditures for public services will be equalized throughout the metropolitan area. Fiscal variations would therefore be eliminated, and residential location could only be influenced by quality differentials with respect to the public sector.

The utility function in Chapter 3 ignores the effects of quality differentials. The measure of fiscal variation is strictly monetary, and it is a ratio of jurisdictional differences in expenditures and revenues. Any fiscal advantages are assumed to be capitalized into the price of housing.

When consolidation is assumed to occur, the first-order conditions for utility maximization change substantially. For the partial derivative with respect to housing services, the term of $H \frac{\partial P_H}{\partial FV}$ (H) drops out. This follows directly from the equalization expression with respect to location is somewhat more complicated. Since government expenditures are invariant to location, the term $U_G G'(k)$ reduces to U_G. $G'(k)$ also drops out of the constraint. The prices of housing services and public goods are also simplified. Both $\frac{\partial P_H}{\partial FV}$ $FV'(k)$ $G(k)$ are equal to zero. This follows from the consolidation assumptions. However, it should be noted that $P_H'(k)$ and $t_R'(k)$ remain because the concept of location retains its neighborhood quality and accessibility characteristics.

From this analysis, it is clear that the effects of fiscal variations on residential location are eliminated under the assumption of a consolidated government. The price of housing services will no longer be capitalized by fiscal variables as in Oates' model. The expenditures for public services and tax rates are homogeneous throughout the metropolitan area.

Therefore, it has been demonstrated that the utility function developed in Chapter 3 is sufficiently flexible to interpret the Tiebout literature and the consolidation simulation. The next section will place the empirical model in Chapter 4 within the utility function discussed here. In this way, the empirical model will be incorporated into the Tiebout literature.

5.3 The Tiebout Hypothesis, Consolidation and the Empirical Results

The utility function has clearly demonstrated the disequilibrium nature of residential location. Unfortunately, empirical models have been restricted to cross-section data, and limitations must be placed

on the interpretation of the results. The empirical model in this section is not an exception to this rule.

The theoretical model in Chapter 3 utilized three different concepts of location: neighborhood quality, accessibility and political jurisdictions. Each of these concepts was incorporated into the location equations of the empirical model. First, race and population density were viewed as proxies for the characteristics of the neighborhood. Second, the change in employment in the suburbs was used as a measure of accessibility. Although this variable was not significant for the middle and upper classes, it was included in each of the location equations. The analysis throughout this study has been primarily in terms of the upper income groups. It was assumed that these groups would be most sensitive to Tiebout forces. Since the accessibility proxy was negative and significant for the lower class, this represented strong evidence that the lower class lacked mobility. Therefore, the emphasis of the discussion on the middle and upper classes is reasonable, and the obvious misspecification is justified by the explanatory value of accessibility in the lower class location equation. Third, the measure of fiscal variation was derived in terms of two jurisdictions. In this respect, it is superior to the measure of Bradford and Kelejian that was developed in terms of income groups rather than location.

The empirical model contained three major dimensions, and each of these will be discussed below. The primary emphasis will be on the location equations, which will be examined in terms of both the income groups and the subsamples. These equations are directly related to both the theoretical model and the Tiebout literature. The second area of interest is the fiscal equations, and they will be evaluated with respect to the subsamples and the literature of section 2.2. Finally, the

simulation results represent the association between the model and the Tiebout and consolidation literature.

The Location Equations

It was stated previously that the location equations were similar to those of Bradford and Kelejian. Two important differences were noted. First, the endogenous variables were calculated in index form rather than in a simple percentage. This method allowed for the estimation of the relative concentration of income groups in each location. The second difference was with respect to the measure of fiscal variation. Bradford and Kelejian's measure was a ratio of the fiscal residuum for middle and lower classes in the central city, respectively. The measure in this study represented fiscal variations between the city and the suburbs. Since the choice of residential location was in terms of the city and suburbs, the latter measure was viewed as more meaningful.

For the total sample, the results of the middle class equation were similar to those of Bradford and Kelejian. The measure of fiscal variation was significant and had the appropriate sign. The size of the coefficient suggests that the middle class is very sensitive to fiscal differentials, and this is consistent with other studies.

One of the assumptions of the Tiebout hypothesis was that of perfect mobility. Since this is clearly not the case, the middle class equation gains increased importance. The results of this equation provide increased support for the validity of the Tiebout hypothesis as a determinant of residential location. Bradford and Kelejian found that fiscal variations between income groups were important in determining middle class location. In this study, it was demonstrated that fiscal differentials between jurisdictions were also significant. Therefore,

the two models can be viewed as mutually supportive with respect to the concept of fiscally-induced migration (the Tiebout hypothesis).

The upper and lower class location equations also provide interesting insights. First, the measure of fiscal variation was not significant for the upper class. This rather surprising result can be resolved by the theoretical model. It was seen that if the marginal utility of public goods approached zero, then the components of location could become an inferior good. It was also argued that the upper class may respond primarily to quality differentials rather than monetary advantages. These two factors would account for the insignificance of the fiscal variable.

The second important insight is that the signs of the coefficients for the lower class equations are the opposite of those for the middle class. This clearly demonstrates that the Tiebout hypothesis is not valid for the lower class, who lack the necessary residential mobility. However, it was suggested that the measure of fiscal variation may not be accurate for the lower class. A measure that relates differential burdens between income groups, such as that by Bradford and Kelejian, may be more appropriate for this group.

The conclusions reached for the total sample change substantially when the results of the subsamples are analyzed. Specifically, the lack of significance for the fiscal variable in the middle class equation in declining areas raises some doubts with respect to the general applicability of the Tiebout hypothesis. This point was first considered by Pollakowski in his criticism of Oates' model. It unfortunately has not been discussed in subsequent studies.

The results from the subsample suggest that the determinants of residential location will vary according to the characteristics of the

metropolitan areas under study. In this model, the subsamples were categorized in terms of the population growth or decline in central cities. An unintended consequence of this classification was that the sample was generally divided along regional lines (i.e. the south and west versus the north and east).

The regression equations for the middle class indicated that neighborhood quality and race were the primary determinants of location in declining areas, whereas the measure of fiscal variation was most important in growing areas. Given the different characteristics of the respective samples, these results are not surprising. It was previously discussed that the declining cities had substantially greater population densities and a significant black population compared to those with population growth. It was therefore expected that these variables would be significant only in declining cities.

These factors also provide an explanation for the significance of the measure of fiscal variation in growing areas. It is clear that these metropolitan areas are relatively homogeneous with respect to the neighborhood and race variables used in the middle class location equation. Therefore, it can be argued that the suburbs and central cities would engage in fiscal competition in order to attract "desirable" residents. This type of competition would not be necessary in declining regions.

The preceding discussion brings out two major conclusions. First, fiscally-induced migration may only be appropriate in areas where other determinants are less significant. This conclusion limits the Tiebout hypothesis in its revised context. Second, the selection of the sample may bias the results of the empirical tests. This suggests that time-series models may be a superior technique for estimating the magnitude of Tiebout forces. Both of these conclusions represent important findings

Although the tax-expenditure capitalization resulted from household mobility, they stated that such capitalization is an indication of excess demand for specific jurisdictions. In the long run, supply adjustments in the public sector would produce a "Tiebout world" where tax-expenditure capitalization would not occur.

The capitalization of fiscal variables is crucial to the model in Chapter 3. The measure of fiscal variation is defined in terms of expenditures and taxes, and both are assumed to vary by location. Therefore, FV'(k), P_G'(k) and G'(k) are all related to the models discussed above.

The analysis in Chapter 3 demonstrated that both FV'(k) and G'(k) were important determinants for the income effect of location. If FV'(k) was positive and large, and G'(k) was relatively small, then location could become an inferior good. However, it is interesting to relate the magnitude of FV'(k) to the models of Oates and Edel and Sclar. Oates found evidence of significant tax-expenditure capitalization in his cross-section omdel. This implies that FV'(k) was large for his sample. Alternatively, Edel and Sclar argued that the capitalization of property values was declining over time, and FV'(k) would be relatively small in this case. It should be noted that Edel and Sclar used a different sample, however.

The implications of this discussion provide some valuable insights into Tiebout models. First, it is apparent that the magnitude of the fiscal variation will differ substantially between metropolitan areas with contrasting characteristics. This was a major conclusion derived from the empirical model in Chapter 4. The second implication is that the degree of fiscal variation will vary over time. Although the Tiebout hypothesis is a model of demand articulation, supply adjustments

are an important factor that have been ignored in the research. This results from the total reliance on cross-section models, a criticism that was also discussed in Chapter 4.

The empirical studies of Aronson and Schwartz and Bradford and Kelejian clearly suggest that fiscal variations are important determinants of location. Specifically, both studies found evidence of a cumulative flight phenomenon whereby the migration of some upper income households provided increased incentive for those remaining to relocate. These studies do have severe limitations, however. First, Aronson and Schwartz do not use econometric techniques, and their model ignores other determinants of location. Second, Bradford and Kelejian derive a measure of fiscal variation that does not consider the differential between central cities and suburbs. Since the two potential destinations are the city and the suburb, this represents a serious deficiency.

The utility function was quite explicit with respect to the impact of fiscal variation on residential location. If housing services and location are normal goods, then ceteris paribus, the household will locate where it receives a fiscal advantage. This was the conclusion reached in the studies above. However, these models did not fully specify the association between housing services, public goods and their respective prices. The utility function in Chapter 3 accomplished this by expanding the definition of location to include accessibility, neighborhood quality and jurisdictions.

Haurin and Tolley develop a model that is based on the assumption that upper income households gain a fiscal advantage by locating in the suburbs. The location of upper income households in the central city results in a social welfare loss. This model is consistent with those discussed above because it only considers location to be a normal good.

The fiscal sector was constructed in this manner to eliminate potential simultaneous equation biases in the location equations. It has been seen that the determinants of expenditures and revenues vary substantially for cities and suburbs in both declining and growing areas. However, an unexpected result from this analysis is that additional support was provided for the existence of the Tiebout hypothesis in growing areas. This reinforces the conclusions drawn from the location equations.

The Simulations

The purpose of the simulations was to interpret the effects of metropolitan consolidation in terms of the Tiebout hypothesis. Within this framework, the magnitude of the Tiebout forces could be estimated. Oates argued that the capitalization of fiscal variables on property values represented a measure of Tiebout-induced mobility. However, it was noted that this was an indirect test at best. Since the model in this study was directly concerned with the locational choice of income groups, it was expected that this method would provide a more accurate order of magnitude.

However, the simulation results must be viewed as disappointing. It was assumed that consolidation would eliminate fiscal variations within a metropolitan area. The effects of this public policy were clearly demonstrated in terms of the utility function in the previous section. With respect to the empirical model, the consolidation simulation was achieved by suppressing the coefficient of the measure of fiscal variation. In this way, it was possible to compare *ex ante* and *ex post* location by income groups for each sample.

The simulation results suggest that residential location was extremely sensitive to consolidation. The middle class demonstrated a

strong movement to the central city, whereas the lower class shifted in the opposite direction. Conversely, the simulated movements of the upper class were relatively indeterminate, with the exception of the sample in growing areas.

The regression results showed that fiscal influences were more relevant in growing areas for the middle class. Therefore, it is not surprising that the simulated movements were of a greater magnitude than those in declining areas. The direction of the movements was expected a priori, but their size can be regarded as excessive.

This inaccuracy can be attributed to two factors. First, the simulation assumed that movements over space were frictionless. This assumption was also made by Tiebout, and it was rightfully criticized. It is obvious that relocations are not costless, and this would particularly affect the lower income groups. If moving costs were incorporated into the simulations, it is likely that the movements would be substantially reduced.

These spatial frictions are directly related to the second factor. It was argued in Chapter 4 that residential location is a dynamic adjustment process. The influence of space is one cause of this disequilibrium. Therefore, a time-series model may be more appropriate for analyzing this problem, and this was also discussed in Chapter 4.

In summary, the results of the consolidation simulation prove that this public policy will have an effect on residential location. This has positive implications for the concept of Tiebout-induced mobility. However, the method has failed to provide an accurate measure of the response to fiscal variations.

5.4 Final Comments

This study has conclusively demonstrated that residential location is a dynamic adjustment process. The theoretical model developed in Chapter 3 acknowledges this fact, yet it is limited in the sense that it considers mobility as the sole response to disequilibrium conditions. A more general approach must include the effects of political processes such as voting and the formation of coalitions. In this way, fiscal variations can be linked to voting at the polls as well as to migration.

The dynamic nature of residential location was apparent from the empirical results. The determinants of location for the middle class varied substantially in growing and declining areas. This was most surprising for the measure of fiscal variation, which was significant only in growing areas. Since the characteristics of metropolitan areas vary widely, cross-section analysis is limited in its ability to explain specific locational attributes. Equilibrium models are severely constrained in the study of residential location.

Therefore, further research will require two modifications of the methodology used in this study. First, the theoretical model should consider alternatives other than migration. As this model, the local government sector was combined with accessibility and neighborhood quality. An obvious extension is to combine club theory with this model before more sophisticated models can be justified.

The second modification concerns econometric techniques. Data limitations are the primary constraint in the search for an improved methodology. This limitation would appear to preclude the use of time-series models, which would be the optimal technique. At the minimum, however, pooling cross-section and time-series data within a generalized

linear regression framework should be employed. This represents a necessary first step toward more rigorous models.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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